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ON
CERTAIN ASPECTS OF OPERATOR'S PERFORMANCE
IN A DECISION TASK

by-

HARJIT SINGH SETHI

A Thesis
Submitted to the Faculty of Graduate Studies
through the Department of Industrial Engineering
in Partial Fulfillment for the
Degree of Master of Applied Science
at the University of Windsor

Faculty of Graduate Studies
University of Windsor
September, 1975

Harjit Singh Sethi 1975

I wish to dedicate this work to my parents and sister.

ABSTRACT

To investigate the effect of information reduction on performance time and pulse rate while subjects performed combined manual and decision tasks (Type II), two sets of experiments were conducted. In the first set, five subjects performed a 3 \times 2 \times 2 completely randomized, factorial experiment in which three levels of information content in the stimuli (N_{Si}) , two levels of information content in the response (N_{R_1}) and two levels of reach (R_k) were tested The $N_{ exttt{Si}}$ levels were 10, 8 and 6 alternatives in which the probability of occurrence of each alternative was equally likely. The two levels of $N_{\mbox{\scriptsize Ri}}$ were 2 and 4 alternatives also occurring with equal probabilities. The response variable for this test was the performance time. The second set of experiments had three independent subsets. In each subset, information in the stimuli was as of 10, 8 and 6 alternatives. The stimuli information (N_{Si}) was not considered as a variable for these tasks. Ten subjects reduced this information (N_{Ri}) to 10, 8, 6, 4 and 2 alternatives in the first subset. Similarly, in other two subsets, the information was

decreased gradually by 2 alternatives till it was reduced to 2 alternatives. Under each condition subjects performed 7 inches and 14 inches of reach respectively. In addition to performance time, pulse rate of subjects while performing these tasks, was also used as a response variable. It has been found that information content in the stimuli (N_{Si}), information content in the response (N_{Rj}) and reach (N_{Rj}) are significant variables that effect performance time and pulse rate difference from its normal level. Both of these increase as the difference between N_{Si} and N_{Rj} decreases.

ACKNOWLEDGEMENTS

The author gratefully acknowledges the assistance of Prof. A. Raouf, who generously supported this project at every stage with encouragement and advice.

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CHAPTER I

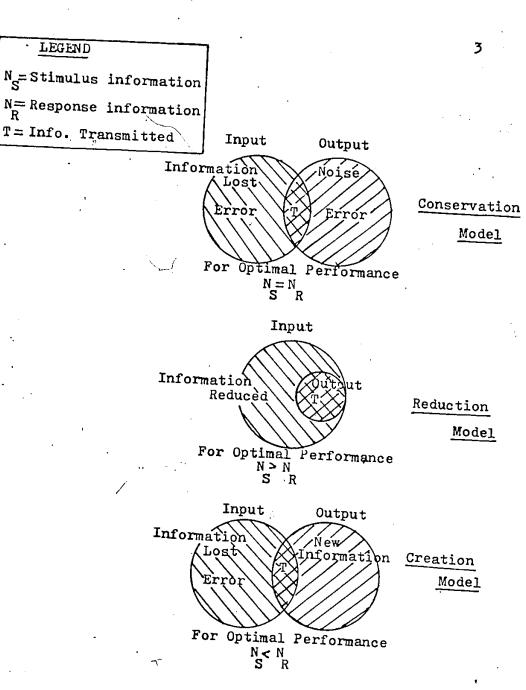
INTRODUCTION

An industrial worker is potentially subjected to two types of 'uncertainty' that he might have to resolve while performing his task. One type of uncertainty could be related to time, i.g. the worker does not know in advance the time at which he is required to respond. The other type could be some form of uncertainty with respect to the selection of response from a finite set of response alternatives. In cases, when the uncertainty over time and uncertainty with respect to response alternatives are eliminated, the task becomes repetitive in nature. From a prediction point of view, such tasks have been termed as Type I tasks (Raouf, 1974). performing tasks in which either type of uncertainty is to be resolved, workers are required to use both of their psycho-motor and decision making abilities. These types of tasks have been termed as 'Combined Manual and Decision Making Tasks' or Type II tasks (Sadosky 1968; Raouf 1974; Thomas 1974).

Well tested techniques for predicting and evaluating human performance for such tasks are not

available to the practitioners of work study. the decision time, obtained by using the concept of choice-reaction time, to the manual time had been suggested in the past. It has been shown that manual times and decision times obtained by using the concepts of information theory are not additive for a given informational load as the magnitudes of motions increase. For these experiments, each signal had 1:1 mapping information conserving tasks. Some of the industrial tasks are/of the nature in which each signal does not necessarily have an explicit response and the worker may be required to make one response for a given subset of stimuli. Such tasks have been termed as Information Reduction Tasks (Posner, 1964). Figure 1.1 represents the various information processing models (Posner, 1964). If $N_{\rm S}$ is the information content in the stimuli and N_R is the information content in the response that the subject has to make, then for error-free performance in the information reduction task, $N_S > N_R$. If $N_S = N_R$, it becomes information conserving task and if N_S < N_R , then it is an information creation task.

The experiments used for the investigations pertaining to Type II tasks had the following factors in common:



LEGEND

Figure 1.1 Illustration of Information Processing Models (After Posner, 1964).

- (i) the subjects were to resolvé choice uncertainty only
- (ii) tasks were of information conserving type (Pew, 1965).

In some other studies it has been shown that heart rate of persons under mental load stabilizes (Kalsbeek, 1967). This stability also known as Sinus Arrhythmia has been suggested as a measure of mental load. The effect of informational load on heart rate while a subject is performing a combined manual and decision task of information conserving type, has already been investigated (Raouf, 1975).

Before a methodology for developing standards for combined manual and decision tasks including information reduction can be developed it was considered essential that our understanding of human performance while performing such tasks be increased. Consequently, the following study was undertakento find out the effect of stimulus information (N_{Si}) , information reduction (N_{Rj}) and two levels of reach (R_k) on;

- (i) Performance Time
- (ii) Pulse Rate Difference.

CHAPTER II

LITERATURE SURVEY

A brief survey of the existing literature pertaining to combined manual and decision tasks, which forms the basis of this study, is provided.

Sadosky (1968) developed a methodology for predicting cycle times for Type II tasks. He estimated manual times using the concept of Information Processing Rate (IPR) based on choice-reaction task. He, for his investigations, used a task in which the probability of occurrence of each alternative from a set of four alternatives was the same.

Raouf (1973) studied IPR and reports that it varies considerably amongst the subjects when the experimental conditions which are known to effect choice-reaction time are kept invariant.

Thomas (1974) explored the interrelationship among various components of Type II task by various types of probability distributions which governed the occurrence of each alternative from a set of four alternatives.

Raouf (1974) has shown that the effect of choice-uncertainty or information load on reach of different magnitudes following the decision in a Type II task, is not the same. For his experiments he used eight, four and two alternative tasks and the different magnitudes of element reach tested were 7 inches, 10 inches and 14 inches.

Some of the psychologists who studied human performance strongly emphasize that information reduction is a predominant situation for the human to work. As regards any theoretical relationship, Posner (1962, 1964), Fits et al (1975, 1967) and Bricker (1955) suggest that a linear relationship should exist between information reduced and various measures of performance. However, the results of their studies cannot be put into use for evaluating worker's performance in the industry because stimulus characteristics of their experiments could not be related to industrial tasks in which decision making and manual motions take place.

Heart Rate

Heart Rate (H.R.) variations due to physiological changes in the human body has been used to measure fatigue, physical work load (Brouha, 1954) operator's performance in industrial tasks (Young 1956). Apart from these studies H.R. variability has also been suggested as a measure of mental load. It has been shown that H.R. pattern of normal healthy subjects sitting at rest is irregular. Momentary irregularity of up to ten or fifteen beats per minute can occur. If one is doing a mental work, this irregularity decreases and the H.R. variability from the resting level of the heart also becomes In medical terms this phenomenon is known as Sinus Arrhythmia. Sinus Arrhythmia occurring alone can be used as a measure of mental load. Kalsbeek and others (Kalsbeek and Ettema 1963, Kalsbeek 1967, Kalsbeek 1971) found that for the situations where physical load is low, Sinus Arrhythmia is monotonically related to the level of the mental load. Boyce (1974) showed that the H.R. and Sinus Arrhythmia change with change in physical load.

While investigating H.R. Variability, Raouf and Khare (1975) found that the H.R. Variability from rest increases as the magnitude of informational load and reach is increased. This was an information conserving type of combined manual and decision task.

CHAPTER III

EQUIPMENT DESCRIPTION

This chapter explains in detail the equipment used for the study and underlines the functions of the various units.

3.1 Methodology

This study was conducted in the Industrial Engineering Laboratory at the University of Windsor. The experiment consisted of recording of performance time and pulse rate of subjects while performing combined manual and decision tasks.

3.2 Performance Time

This is the elapsed time between appearance of a visual stimulus and the completion of response.

This time can be divided into the following elements:

- (1) occurrence of stimulus
- (2) detection of stimulus
- (3) decision time
- (4) selection of response
- (5) movement of hands
- (6) completion of response.

Figure 3.1 represents the block diagram of combined manual and decision tasks when the task is repetitive in nature and the manual motions are discrete.

3.3 Experimental Set-Up

The experiment consists of two main units:

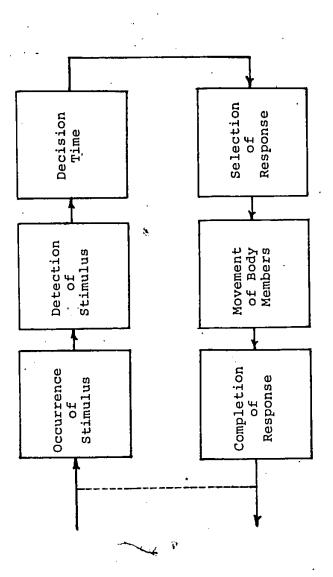
- (1) Multi-choice (10 Channel) Reaction
 Time Apparatus
- (2) Pulse Rate Recorder.

1. Multi-choice Reaction Time Apparatus

The experiment has been conducted on the multichoice reaction time apparatus. Detailed description of this experiment is given in reference 16. This equipment consists of the following three units:

- (i) Signal Response (S-R) Unit
- (ii) Tape-Reader
- (iii) Time Measuring and Recording Unit.
- (i) Signal Response Unit (For details see figures 1 4, Appendix A)

S-R unit houses the decoding circuits, error and total trial indicators, 'scramble' matrix and other control circuitry. The front panel has ten lights (source of stimuli) about 3/8 inches diameter and ten response switches (R.S.) mounted on it below the lights. Also, it has an initiate button (I.B.)



1

Block Diagram Showing Various Activities While Subject Performs a Combined Manual and Decision Task. Figure 3.1.

which can slide in the guide. The I.B. is used to activate the stimulus lights. The distance of I.B. from R.S. #5 and #6 can be adjusted from 7 inches in position I and 14 inches in position II. The rear panel houses an error indicator, a total trial indicator with counter re-set push button switches.

The Error Counter

The stimulus lights can be turned on by pressing the I.B. and turned off only by pressing the R.S. associated with that stimulus. The timer-counter keeps running till the proper response has been made. Due to error in selection of response button, the counter advances by one. The error counter thus keeps a record of the number of incorrect responses made by the operator under test. The performance time for these response cycles is unusually high and can be detected and eliminated for the purpose of analysis. Total Trial Indicator

This registers the total number of cycles including the cycles in which the wrong R.S. was pressed. The trial indicator as well as the error counter can be set to zero by pressing the reset buttons. Both are of electro-mechanical types. Thus this indicator helps to keep a record of total performance cycles performed under any experimental condition.

Scramble Matrix

Through this matrix any of the signal lights can be connected to any of the R.S. This matrix has (10 x 10) plug holes in which plugs can be inserted to connect different lights to a R.S. In other words, the scramble matrix (encoder) allows the experimenter to program any R.S. and light or lights combination he so chooses.

Response Switch Sliding Covers

Any of the R.S. which is not in the scheme of connections is covered by an aluminum slide attached with lever used for sliding it. See Appendix A, Figure 1 for details.

(ii) Tape Reader

generator. The tape is programmed so that any of the lights on the S-R unit will light up in a random pattern. Depending on the hole pattern in the tape, the tape reader sends out a combination of electrical signals (BCD) which are decoded in the S-R unit and the result displayed on the front panel signal lights. The tape can be so programmed that the pattern of display of lights can be made to obey any of the probabilities law. Therefore, it controls (i) the size of the set of N_{Si} and, (ii) the sequence of occurrence of N_{Si}.

A SLO-SYN tape reader has been used for the present. study.

Preparation of Punch Tape

This is a standard computer paper tape which can be punched on any of the teletype punching machines using an IBM code. The sequence of punching of characters has to be such that when I.B. is pressed any of the light comes on and when the R.S. is pressed, the light is switched off. Tapes were prepared for 10, 8 and 6 alternatives tasks with equal probabilities of occurrences in a set.

(iii) Time Measuring and Recording Unit

This consists of a Hewlett-Packard 5326 A Timer Counter and a paper tape punch unit. It records in milliseconds the time elapsed between the coming of the signal and making of the response. The DIGITEC punching equipment comprised of a tape punch controller and a paper tape punch models 625 and 672. The performance time and light number for each cycle is punched on the tape. This tape is converted into data cards for the analysis.

2. Pulse Rate Recorder

It is a portable pulse monitoring equipment with a sensor-clip which is attached to the left-hand index finger of the operator. It continuously computes and averages every four consecutive pulses

of the operator and displays digitally on the screen. These averages are recorded manually by the attendant on the paper while the operator performs. This instrument is accurate to within ± 1% between the rate of 30 and 130 beats/min.

An Electronic/Medical System, Pulse Trac Unit has been used for this study.

3.4 Procedure

Figure 3.2 shows the diagram representing block layout of the equipment.

This experimental unit was placed in one of the laboratories of Industrial Engineering having proper air-conditioning and lighting arrangements. Before the commencement of testing of each subject, a trial was held to check the equipment. The subject performed after this. His task comprised of the following steps:

- (i) Press the I.B. (preset to a certain

 'Reach') with right hand index finger.

 The associated light was switched on.
- (ii) Reach for the corresponding R.S. and press it. The light is switched off.

If the R.S. is one associated with the signal, the light went off and the recording unit punched out the time elapsed and the corresponding light number. And if the R.S. is not the one associated

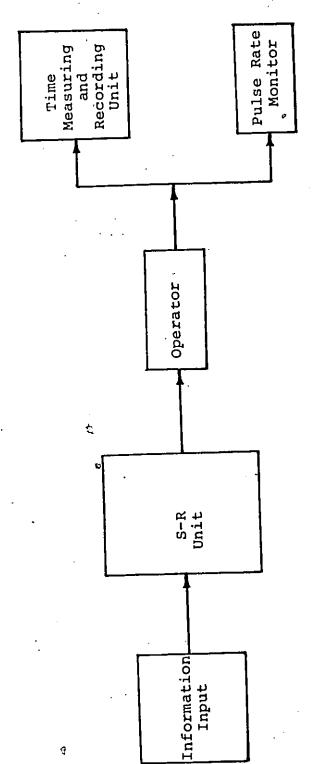


Diagram Showing the Block Layout of the Equipment. Figure 3.2.

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with the signal, time elapsed is not recorded till the correct response is performed.

3.5 Instructions to the Subjects

Before the start of the above test, there was a set of instructions given to each subject in order to minimize experimental errors particularly with regards to reach so that the subject does not make unnecessary hand movements while searching for the R.S. The following instructions were given to each subject:

- (i) He was instructed to move his right hand index finger from the I.B. till he determined the corresponding R.S.
- (ii) He was to feel free—to ask for more rest if feeling tired.
- (iii) Task was performed in short sleeve shirts.

The two studies conducted are described in detail in the next chapters.

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CHAPTER IV

THE STUDY

4.1 Objectives

The following were the objectives of this investigation:

- (i) to find out if for given information levels in the responses (N_{Rj}) and for different information levels contained in stimulus (N_{Si}) and for different magnitudes of reach (R_{k}) , the performance time is significantly affected or not. This study has been named as the Pilot Study.

4.2 The Pilot Study

This study has been done by taking three sets of stimuli with different information contents. The information in the stimuli ($N_{\rm Si}$) is the same as in

6, 8 and 10 alternatives tasks in which the occurrence of stimulus is equally likely. Under each set of stimulus, the information in the response (N_{Rj}) was kept at two levels of 2 and 4 alternative task. The effect of above two variables and two levels of reach of 7 inches and 14 inches was tested on performance time of subjects.

4.21 Validity for NSi, NRi and Rk for the Study

In the research being done on decide action, it has been established that if there are more than 16 alternatives in the stimulus which are presented to the operator, mental overload occurs and the efficiency of the operator falls in repetitive kind of work. For such cases it has been suggested that there is need for more than one operator to do the same job (Bayha, Hancock)*. Keeping this in view, the design of the work place which is the signal-response unit is kept at a maximum of 10 alternatives.

Commonly, it has been seen that the number of responses associated with the number of signals or stimulus are less than the number of stimulus.

Examples of such situations can be manual sorting, monitoring and sensing devices.

The 'Reach' distances of 7 inches and 14 inches are chosen because there is no body assistance for the

^{*}Application Guidelines on Decide Action Research published by MTM Association, Fairlane, New Jersey.

moves corresponding to those reach distances and the above distances are most frequently used in work design.

4.22 Validity for the Occurrence of Stimuli and Response and Information Measurement

Researchers studying the decision component performance in an isolated form through choice-reaction time studies empirically arrived at a linear relationship between performance time and the "uncertainty" of the stimulus set using Shannon's information metric (Shannon 1969). This uncertainty according to information theory is termed as entropy and is given by:

$$H(P) = -\sum_{i} p_{ij} \sum_{j} p_{ij} \log_{2} p_{ij} \text{ bits,}$$
 (1)

where p_i is the probability that stimulus i occurring from the finite set of alternatives $\{1, \ldots, N\}$, and p_{ij} is the conditional probability of j occurring given that i occurred on the previous cycle. If there are no sequential dependencies, i.e. $p_{ij} = p_j$ for all i, eqn. (1) reduces

$$H(P) = -\Sigma_{j} p_{j} \log_{2} p_{j} \text{ bits,}$$
 (2)

In real industrial tasks involving combined manual and decision tasks, the probabilistic conditions for occurrence of stimuli can obey different discrete probability laws depending on the nature of the job.

In an investigation done by Satsangi (1974) on a fabric sorting operation, the occurrence of different choices was observed to follow a poisson process.

Similarly, for different situations one can expect arrival patterns for the occurrences of stimuli to obey different probabilistic laws. Keeping this thing in view, for the present study, it has been taken that among number of choices, the probability of occurrence of each stimulus and the response is the same as that of the rest.

In the above case, if there are 'n' alternatives present in the stimuli, then $p_j = \frac{1}{n}$, the eqn. (2) reduces to;

$$H(P) = -\sum_{j=1}^{n} \frac{1}{n} \log_2 \frac{1}{n} \text{ bits}$$

$$= -n \frac{1}{n} (-\log_2 n) \text{ bits}$$

$$= \log_2 n \text{ bits}$$
(3)

'n

i

.

The same expressions hold good for the information content in the response which the operator has to make in order to conserve or reduce information.

4.23 Experimental Conditions

Denoting stimulus information as N_{Si} , response information as N_{Rj} and reach as R_k , where i, j, and k represent the levels of these effects. Figure 4.1 shows the graphical representation of experimental conditions for the Pilot Study.

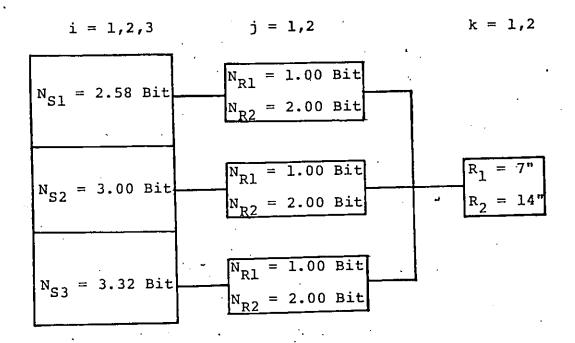


Figure 4.1. Graphical Representation of Experimental Conditions for the Pilot Study.

4.3 The Major Study

Based on the results of Pilot Study, the stimulus information has not been taken as a variable but instead three independent experiments under 3.32 bits, 3.00 bits and 2.58 bits of stimulus information (N_{Si}) have been undertaken. The effect of different N_{Rj} levels and reach (R_k) of 7 inches and 14 inches was tested on performance time and pulse rate difference of subjects. The pulse rate difference (P.R.D.) of subjects is defined as -

P.R.D. = Pulse Rate at Rest - Pulse Rate at Work

4.31 Experimental Conditions

Total experimental conditions for this set of three experiments can be put as follows -

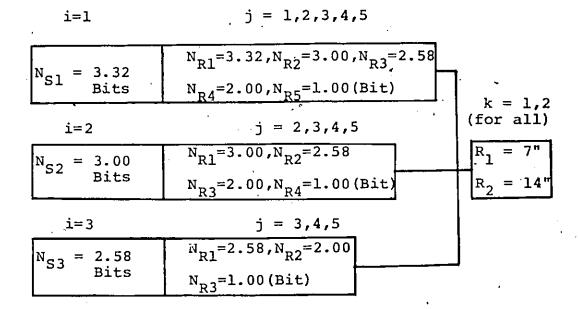


Figure 4.2. Graphical Representation of Experimental Conditions for the Major Study.

4.4 Methodology

As explained, three sets of stimuli information have been taken for this study. If the occurrence of stimuli is equally likely, then 6, 8 and 10 alternatives represent 2.58, 3.00 and 3.32 bits of information. Light numbers 3 to 8, 2 to 9 and 1 to 10 of S-R unit are chosen to form the sources of stimuli (see appendix A for S-R details). As the information is being reduced from these sets, it is obvious that less number of responses are associated with the same stimulus, i.e., $N_{Si} > N_{Ri}$, the occurrence of response is also kept equally probable by programming the tapes for lights accordingly. Appendix B explains in detail the S-R connections, number of performance cycles taken for each condition. It also describes the steps taken in preparation and programming the tapes for the tape reader.

Pulse rate of each subject was recorded before the start of the experiment while he was at rest. This was done by putting the sensor clip of the pulse recorder to the forefinger of any hand (see Appendix A).

4.5 Deviations in Response Information (NR)

In some experimental conditions when signal to response (S/R) ratio is not a whole number, the information in the response (N_{Rj}) changes because occurrence of response cannot be kept equally likely. The following table gives the combination of signal and responses in terms of alternatives in which these deviations from N_{Rj} occur and the corresponding percentages of error involved. Appendix B gives these calculations.

S/R Ratio	% age Deviation in N _{Rj}
10/8	2.29
10/6	2.30
10/4	1.50
8/6	3.10
6/4	4.20

Table 4.1. S/R Ratios and the Corresponding Deviations in \mathbf{N}_{Rj} .

4.6 The Subjects

Fifteen male graduate research students in the Faculty of Engineering were selected as subjects for this study. Five subjects were taken for the pilot study and the rest for the major study. Table 4.2 and 4.3 give the details of the students. These

subjects were paid at the university wage rate. All were in good physical condition and were interested in the studies being undertaken. The equipment was shown to the subjects and the function of each unit was explained to them and all were given 400 practice cycles before the start of the experiment.

The pilot study lasted for three hours per subject while the major study took around six hours per subject. Each experimental condition took approximately 10 minutes with 3 minutes of rest in between. The subjects were given 50 practice cycles before each condition to adapt themselves to the changed conditions.* One subject was tested each day.

Name (Initials)	Age (Years)	Profession
G.A.	23	Grad. Student
K.A.	. 22	Grad. Student
M.W.	23	Grad. Student
S.H.	24	Grad. Student
T.J.	24	Grad. Student

Table 4.2. Details of the Subjects for Pilot Study.

^{*}See Appendix B for explanation of Signal Response Compatibility.

Name	(Initials)	Age (Years)	Profession
	G.A.	23	Grad. Student
	J.S.C.	23	Grad. Student
	M.V.R.	26	Grad. Student
	M.W.	23	Grad. Student
	S.E.	26	Grad. Student
	A.M.	24	Grad. Student
•	E.B.	22	Grad. Student
	M.A.	20	Undergraduate
	M.Y.	24	Grad. Student
	To.	24	Grad. Student

Table 4.3 Details of the Subjects for Major Study.

4.7 Experimental Design

For the pilot study each subject has been tested under $(3 \times 2 \times 2)$ completely randomized, full factorial experiment. The order of set information (N_{si}) , information reduced (N_{Rj}) and reach (R_k) levels were selected at random and it varied for each subject. The order of randomization for this study is given in table 4.4.

In the three experiments carried out in the major study, the designs are (5×2) , (4×2) and (3×2) completely randomized, full factorial experiments. The order of three subsets has also

	-			_		•	
S.	2.00	R ₂	8	, 	11	12/	3
N _{S3} =3.32 Bits	N _{R2} =2.00	R	10	12	7	80	2
¹ _{S3} =3.	$N_{R1}^{=1.00}$	R ₂	12	7	Ŋ	7	12
	NR1=	R ₁	7	б	12	4	4
8	$N_{R2}=2.00$	R ₂	5	10	٣	10	1J
O Bits	NR2=	Rı	m	7	47	7	6
.N _{S2} =3.00	1.00	R2	6	11	н	9	10
N .	N _{R1} =1.00	$^{R}_{1}$	11	Э.	7	6	2
S	2.00	R ₂	τ	co	10	ល	6
8 Bits	N _{R2} =2.00	R	9	ا ن	9	т	8
N _{S1} =2.58	1.00	R ₂	4	, 5	6	11	Н
Z	NR1=1	R1	. 2	9	ω	н	7
NSi	NRj	R _K	G.A.	K.A.	м. м.	S.H.	T.J.

Order of Randomization of Experimental Conditions of Pilot Study for Each Subject. Table 4.4.

The entries denote the sequence in which each condition was tested. Note:

been randomized. Tables 4.5 to 4.8 represent the scheme of randomization for these subsets and their experimental conditions.

Subjects ets	1	2	3	4
G.A.	.2	1	3	
J.S.C.	3	2	1	
M.V.R.	1	2	3	
M.W.	2	3	1	l
S.E.	3	1	2	
A.M.	2	1	3	l
E.B.	1,	3.	2	
M.A.	2	3	1	
M.Y.	1	2	3	
T.J.	3	1	2	

Table 4.5. Order of Randomization of Subsets of Major Study for Each Subject.

Note: The entries denote the sequence in which each set was tested.

	•				
	·	1.00	R2	H 0 7 0 0 0 0 0 4 4	
	·	N _{R5} =1.00	Rl	10 10 10 10 10 10	
	:	2.00	R2	22 7 7 7 7 7 8 8 8 5 5	
		$N_{R4} = 2.00$	Rl	100 8 8 8 7 8 7 8 10 10 10 10 10 10 10 10 10 10 10 10 10	
	3.00 N _{D2} =2.58	2.58	R2	10 12 12 13 10 10	
N _{S1} =3.32 Bits		, i	N R3	Rl	2 10 3 6 8 8 10
1=3.32		3.00	R2	4814294576	
S S		N _{R2} =3.00	RI		
		3,32	R2	13 10, 10,	
	•	N _{R1} =3.32	Rl	10 10 10 12 12 13	
		N _{Rj} (Bits)	R _k (Ins.)	G.A. J.S.C. M.V.R. M.W. S.E. A.B. M.A.	
		[

Order of Randomization of Experimental Conditions for Subset 1 for Each Subject when $\rm N_{S1}\!=\!3.32$ Bits. Table 4.6.

The entries denote the sequence in which each condition was tested. Note:

N _{S2} =3.00 Bits								
N _{Rj} (Bits)	N _{R1} =	3.00	N _{R2} =	2.58	N _{R3} =	2.00	N _{R4} =	1.00
R _k (Ins.)	R1	R2	R1	R2	Rl	R2	Rl	R2
G.A. J.S.C. M.V.R. M.W. S.E. A.M. E.B. M.A. M.Y. T.J.	7 1 2 3 8 5 2 4 6 3	2 7 6 4 6 1 3 5 4 7	4 6 8 1 3 2 8 3 1 2	3 2 1 5 7 6 4 7 8 5	8 5 3 7 2 4 1 6 7 8	6 4 5 8 1 7 5 2 3 6	1 8 4 2 5 3 6 8 5 1	5 7 6 4 8 7 1 2 4

Table 4.7. Order of Randomization of Experimental Conditions for Subset 2 for Each Subject when $N_{\rm S2}$ = 3.00 Bits.

	N _{S3} =2.58 Bits							
					-			
N _{Rj} (Bits)	N _{R1} =	2.58	N _{R2} =	2.00	N _{R3} =	1.00		
R _k (Ins.)	Rl	R2	Rl	R2	Rl	R2		
G.A. J.S.C. M.V.R. M.W. S.E. A.M. E.B. M.A. M.Y. T.J.	4 3 2 6 1 3 5 1 4 2	1 5 6 1 4 2 3 6 2 3	5 1 5 3 2 4 6 2 6 4	3 5 4 2 6 1 4 5 1 6	2 4 1 5 3 5 2 3 5 1	6 2 3 4 5 6 1 4 3 5		

Table 4.8. Order of Randomization of Experimental Conditions for Subset 3 for Each Subset when $N_{\rm S3}^{=2.58~\rm Bits.}$

Note: The entries denote the sequence in which each set was tested.

The conditions under which each subject was tested for the major study can be summed up in the following Table 4.9.

	R	ı ⁼⁷ "		R	2=14"	
	, N _S	i (Bit	s)	, ^N S	i (Bit	s)
N _{Rj} (Bits)	3.32 3.00 2.58 2.00 1.00	3.00 2.58 2.00 1.00	2.58 2.00 1.00	3.32 3.00 2.58 2.00 1.00	3.00 2.58 2.00 1.00	2.58 2.00 1.00 -

Table 4.9. Total Experimental Condition for the Major Study.

4.8 Data Collection

The performance time associated with every response switch was collected but the performance time for R.S. #5 and R.S. #6 which are at the required distances from I.B. has to be analyzed. The data associated with other response switches has not been taken for the purpose of analysis. For the pilot study, 70 observations associated with R.S. #5 or R.S. #6 and the mean taken for each condition. But for the major study, mean of 35 observations associated with R.S. #5 and R.S. #6 per condition

has been taken. Less number of observations for the experimental conditions of major study has been taken because it was observed that there is no significant difference in the mean values for one particular condition if more than 25 observations for such type of tasks are taken. Moreover, by taking 35 observations per condition of the major study there is a considerable saving in time and labor including boredom to the subjects is reduced.

Pulse rate of each subject was taken and recorded in the beginning of the experiment of major study while they were at rest.

Nine observations per experimental condition were taken for the pulse rate. These observations were recorded after every minute from the commencement of each experimental condition. But for this purpose of analysis, mean of last six observations has been taken because in doing so pulse rate of the subjects has very little effect of the previous condition and moreover the subject is adjusted to that condition.

The errors made by the subjects for each experimental condition in terms of pressing the wrong R.S. were less than 1%.

CHAPTER V

DATA ANALYSIS AND RESULTS

5.1 Technique Employed

Tables 1 to 7, Appendix C give the mean values of performance times and pulse rate differences (P.R.D.) for individual subjects. Histograms for only performance time has been plotted by a standard computer program (see Appendix H). The computer outputs beside means has given standard deviation, minimum and maximum values of performance times. It also gives the total observations taken for each condition, their ranges, frequency of occurrences and their expected values. Appendix F gives these histogram plots and the related information.

Analysis of variances (ANOVA) has been used to analyse the data. This is taken because the overall differences among the means of several experimental groups can be evaluated.

The following mixed model has been used to analyse the performance time data for the pilot study:

$$X_{ijk\ell} = \mu + \alpha_i + \beta_j + \gamma_k + \delta_\ell + \alpha\beta_{ij} + \alpha\gamma_{ik}$$

$$+ \alpha\beta\gamma_{ijk} + \dots + \alpha\beta\gamma\delta_{ijk\ell}$$

where α_i = N_{Si}, i = 1,2,3; B_j = N_{Rj}. k = 7.2 N_{S1} = 3.32 bits, N_{R1} = 1.00 bit N_{S2} = 3.00 bits, N_{R2} = 2.00 bit N_{S3} = 2.58 bits, γ_k = R_k, k = 1,2; δ_ℓ = subjects R₁ = 7", Response Variable = Performance Time R₂ = 14".

 $x_{ijk\ell}$ is the mean performance time for the ith stimulus information level, jth information reduction level, kth reach and ℓ th subject.

In the above model δ , β and γ are taken as fixed factors while δ is considered as a random factor.

For the major study, the stimulus information (N_{Si}) is not considered independent variable, therefore, the mixed model used for each subset (N_{Si}) of the major study is

$$X_{ijk} = \mu + \alpha_i + \beta_j + \gamma_k + \alpha\beta_{ij} + \alpha\gamma_{ik} + \beta\gamma_{jk} + \alpha\beta\gamma_{ijk}$$

```
where \alpha_i = N_{Rj}, for Subset 1, j = 1, 2, ..., 5.
                         N_{Rl} = 3.32 \text{ bits}
                         N_{R2} = 3.00 \text{ bits} tested under N_{R3} = 2.58 \text{ bits} N_{S1} = 3.32 \text{ bits}
                         N_{R4} = 2.00 \text{ bits}
                         N_{\tilde{R}5} = 1.00 \text{ bit}
                          for Subset 2, j = 1, 2, ..., 4
                      N<sub>Rl</sub> = 3.00 bits
                          N_{R2} = 2.58 \text{ bits} tested under N_{R3} = 2.00 \text{ bits} N_{S2} = 3.00 \text{ bits}
                          N_{R4} = 1.00 \text{ bit}
                          for Subset 3, j = 1,2,3,
                          N_{Rl} = 2.58 \text{ bits}
N_{R2} = 2.00 \text{ bits}
tested under
N_{S3} = 2.58 \text{ bits}
                           N_{R3} = 1.00 \text{ bit}
      \beta_k = R_k, k = 1.2; \gamma_k = Subjects
                       Response Variables -
                           (i) Performance Time
      R_2 = 14",
                               (ii) Pulse Rate Difference (P.R.D.)
```

A standard computer package known as Statistical Analysis System (Barr and Goodnight) has been used to compute sums of squares of various effects (see Appendix G).

Tables 5.1 to 5.7 show the findings of pilot and major studies showing only the main effects. F-ratios are compared with standard tables for $\alpha = 0.05$ (Hicks, 1973). Results indicate that all the main effects are significant. Complete details of ANOVA are given from Tables 9 to 15, Appendix C.

Source	DF	MS	F	Findings
N _{Si}	2	27609.267	79.83	Significant (P < 0.05)
Rj	1	138712.723	34.47	Significant (P < 0.05)
R _k	1	19175.943	20.32	Significant (P < 0.05)

Table 5.1. Analysis of Variance for Performance Time of Pilot Study (Main Sources of Variation Only).

Source	DF	MS	F	Findings
N _{Rj}	4	23166.5335	13.17	Significant (P < 0.05)
R _k	1	16467.5623	30.29	Significant (P < 0.05)

Table 5.2. Analysis of Variance for Performance Time of Subset-Set I of Major Study (Main Sources of Variation Only).

Source	DF	MS	F	Findings
N _{Rj}	3	27312.1934	14.20	Significant (P < 0.05)
R _L	1	11265.8175	45.18	Significant (P < 0.05)

Table 5:3. Analysis of Variance for Performance Time of Subset-II of Major Study (Main Sources of Variation Only).

Source	DF	MS	F	Findings			
N _{Rj}	2	8593.9845	9.55	Significant (P < 0.05)			
R _k	1	10284.8134	3.16	Significant (P < 0.12)			

Table 5.4. Analysis of Variance for Performance Time of Subset-III of Major Study (Main Sources of Variation Only).

Source	DF	MS `	MS F Finding			
N _{Rj}	4	52.10	3.71	Significant (P < 0.05)		
	1	190.67	46.50	Significant (P < 0.05)		

Table 5.5. Analysis of Variance for P.R.D. of Subset-I of Major Study (Main Sources of Variation Only).

Source	DF	MS	F	Findings
N _{Rj}	3	56.79	3.21	Significant (P < 0.05)
R	1	138.88	56.68	Significant (P < 0.05

Table 5.6. Analysis of Variance for P.R.D. of Subset-II of Major Study (Main Sources of Variation Only).

Source	, DF	MS	F	Findings
N _{Rj}	2	91.12	6.18	Significant (P < 0.05)
R _k	. 1	106.96	23.61	Significant (P < 0.05)

Table 5.7. Analysis of Variance for P.R.D. of Subset-III of Major Study (Main Source's of Variation Only).

5.2 Test on Means After Experimentation

Having concluded that there is a significant difference in treatment means, the next step would be to find out which means are different. As we are investigating the effect of different stimuli and responses on performance time and pulse rate difference, a test called Newman-Keuls Range Test (Hicks, 1973) has been put to evaluate these differences.

Appendix C (calculations) show that for the pilot study, stimulus information level means are significantly different from each other ($\alpha=0.05$).

For the major study, reach level means are also significantly different for all the subsets of performance time as well as for pulse rate differences.

5.3 Computation of Variances for Various Effects

The variances for the main effects has been calculated in order to see what percentages are attributable to N_{Rj} and R_k levels for each set of N_{Si} . Also, the variances for individual N_{Rj} has been calculated. These variances are listed in the following tables from 5.8 to 5.11 (for calculations see Appendix C).

N _{Si} (Bits)	Ŋ _{Ŕj} %	R _k %
3.32	26.00	7.76
3.00	26.83	5.82
2.58	6.82	4.15

Table 5.8. Percentages of Variances Attributable to N and R Levels for Performance Times:

N _{Si} (Bits)	N _{Rj} %	R _k %		
3.32	20	40		
3.00 /	19	56		
2.58	39	35		

Table 5.9. Percentages of Variances Attributable to N_{Rj} and R_k for P.R.D.

N _{Si} (_{Bits})(Bits)	3.32	3.00	2.58	2.00	1.00
3.32	7.60	13.25	5.78	0.01	73.00
3.00		15.16	13.28	0.70	70.76
2.58			15.55	17.81	66.59

Table 5.10. Percentages of Variances Attributable to Individual ${\rm N}_{\rm R\,\dot{I}}$ Means of Different Sets for Performance Times.

NSi (Bits)	3.32	3.00	2.58	2.00	1.00
3.32	60.50	3.60	2.00	10.67	23.26
3.00		58.75	1.37	15.18	24.68
2.58			50.00	2.00	48:00

Table 5.11. Percentages of Variances Attributable to Individual $N_{\mbox{Rj}}$ Means of Different Sets for P.R.D.

5.4 Graph Plotting

The graphs are plotted (Appendix D) for both the studies between N_{Rj} , performance times and pulse rate differences for different N_{Si} and R_k . The graphs are also plotted between $(N_{Si}-N_{Rj})$, performance time and pulse rate differences.

These graphs indicate that performance time and pulse rate difference increase as $(N_{Si} - N_{Rj})$ decreases.

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5.5 Regression Analysis

In order to find prediction models for performance time and pulse rate difference for combined manual and decision tasks of this nature, polynomial regression analysis has been done. A computer program (see Appendix H) is put to fit a least square curve to the data of all the subsets of major study.

Appendix E (computer outputs) shows that for any subset of stimulus information (N_{Si}) and response information (N_{Rj}) , performance time and pulse rate difference can be predicted for both reaches of R_1 and R_2 . For the subset when $N_{S1}=3.32$ bits, 1st to 4th degree polynomial can be inserted to the data for each of the reaches. Similarly, a maximum of 3rd and 2nd degree polynomials can be inserted to subsets 2 and 3 respectively. For example, for the first subset of performance, the first degree polynomial for R_1 (see computer outputs) is -

Performance Time (ms) = $500.68 + 31.80 N_R$

where N_R = stimulus information in bits. The % age average error involved in prediction by the above equation is 1.64.

There is a gradual decrease in % age average errors as the degrees of polynomial increase till it is 0.00 at the maximum level. The 4th degree polynomial for the above equation is -

Performance Time (ms) = 1388.00 - 1925.15 N_R + 1467.00 N_R^2 - 451.21 N_R^3 + 49.01 N_R^4

The % age error involved in prediction by the above equation is 0.00.

The following tables summarize the percentages of average errors involved in each degree of polynomials for all the subsets.

	R ₁ = 7"				R ₂ = 14"			
	Degree of Polynomial				Degr	ee of	Polyno	mial
N _{Si} (Bits)	1.	2	3	4	1	· 2	3	4
3.32	1.64	0.59	0.56	0.00	2.28	0.53	0.50	0.00
3.00	1.909	0.37	0.00		1.87	0.34	0.00	
2.58	1.38	0.00			0.85	0.00		

Table 5.12. Percentages of errors involved in each degree of polynomials for the performance times.

ø	R ₁ = 7"				R ₂ = 14"				
	Degree of Polynomial				Degr	ee of	Polyno	mial	
N _{Si} (Bits)	1	2	3	4	1	2	. 3	4	
3.32	5.47	1.69	1.08	0.00	6.22	2.70	0.08	0.00	
3.00	8.93	0.89	0.00	<u></u>	4.73	0.30	0.00		
2.58	2.76	0.00			2.21	0.00			

Table 5.13. Percentages of errors involved in each degree of polynomials for the pulse rate differences.

Owing to large number of equations involved for prediction, it was thought to develop general equations for prediction of performance times and pulse rate differences and for the easiness of formulation, a linear relationship has been assumed between $N_{\rm Rj}$ and both the response variables. These equations can be used when the information in the stimuli and response has been ascertained. The equations are —

Performance Time (ms) = RAD" + CD" + 33.33 N_R

where RAD" = time taken in ms by reach distance of class A*

 $N_{\rm R}$ = information in the response in bits

CD" = experimentally determined constants (ms) based on N_{Si} and R_k levels). (These values are given in Appendix E).

The average error involved in this prediction equation is approximately 15%.

The P.R.D. in beats/min. can also be predicted by the equation;

P.R.D. (beats/min.) = KD" + 2.10 N_R

^{*}The MTM data card describes class A reach: Reach to an object in fixed location, or to object in other hand or on which other hand rests. (Published by The Maynard Foundation, Pittsburgh, Pa.).

where N_R = information in the response in bits KD" = experimentally determined constants (ms) based on N_{Si} and R_k levels. (These values are given in Appendix E).

The average error involved in this prediction equation is approximately 20%.

The practitioners of work study can use the above equations for approximate estimation but if a precise estimation is required, the highest order polynomial for a given N_{Si} , N_{Rj} and R_k can be used.

Further validation of the above findings is suggested before they are used by the work designers.

CHAPTER VI

CONCLUSIONS AND SUGGESTIONS FOR FURTHER STUDY

For a Typle II task where subjects are required to resolve uncertainty related to choice alternatives and information reduction is involved ($N_{Si} > N_{Rj}$) and the cycles are discrete and repetitive, the following conclusions can be made:

- 1. For $N_{Rj}=1.00$ bit and $N_{Rj}=2.00$ bits, N_{Si} is a significant variable affecting performance time.
- 2. For a given N_{Si} , N_{Rj} and R_{k} are significant variables affecting performance time.
- 3. Also, for a given N_{Si} , N_{Rj} and R_k are significant variables affecting pulse rate difference.
- 4. Performance time increase as $(N_{Si} N_{Rj})$ decreases. This is shown in Figures 7 and 8, Appendix D.
- 5. Pulse rate difference also increases as $(N_{\mbox{Si}}-N_{\mbox{Rj}}) \mbox{ decreases. Figures 9 and 10, Appendix D.}$
- 6. Tests on means of N_{Rj} levels of performance time show that all the means are significantly different from only one level when $N_{Rj}=1.00$ bit where the performance time is minimum. This is true for all the subsets.

- 7. Means of N_{Rj} levels of pulse rate difference indicate that for all subsets means of N_{Rj} = 1.00 bit and N_{Rj} = N_{Si} are significantly different from each other. The means in between do not differ.
- 8. Breakdown of variances for individual $N_{\rm Rj}$ levels for the pulse rate difference for all $N_{\rm Si}$ levels indicate that extreme levels, i.e. $N_{\rm Rj} = 1.00$ bit and $N_{\rm Rj} = N_{\rm Si}$ contribute more towards variation than any other level in all the subsets (Chapter IV).

6.1. Suggestions for Further Studies

A function relating N_{Si} , N_{Rj} and R_k for the performance time has been formulated in this study. But further validation is suggested before it is put in use because of the accuracy and the assumptions involved.

The effects of information creation for Type II tasks have not been looked into yet. A study in this direction is suggested before the study for such tests is regarded as complete.

APPENDICES

APPENDIX A

EQUIPMENT DESCRIPTION



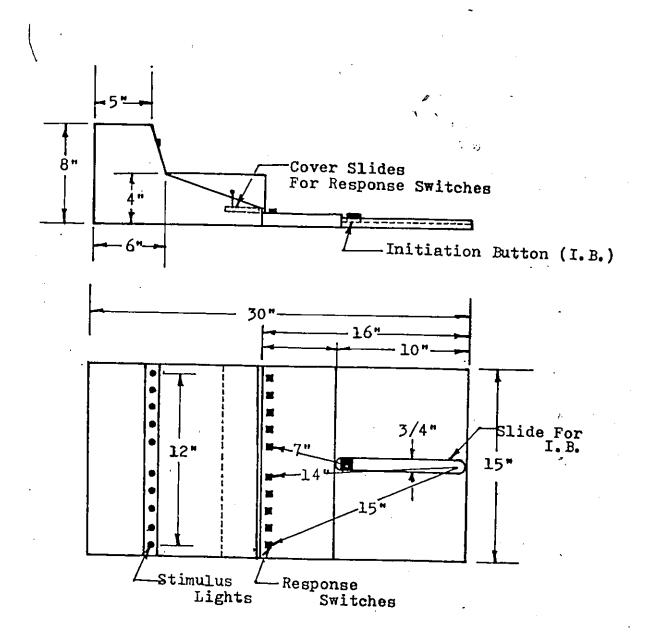
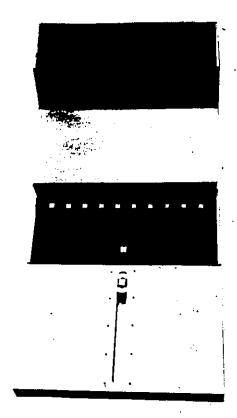
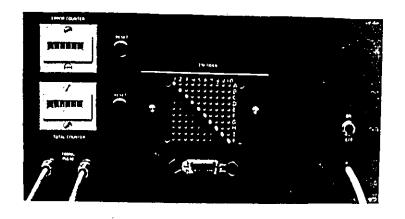


Figure 1. Details of Signal - Response Unit.

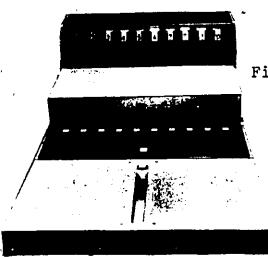


Top-View



· B

Rear-View



Front-View

Figure 2. Pictorial Views of the Signal-Response Unit.



Figure 3. Pulse Rate Monitor with Sensor-Clip attached to the Forefinger.

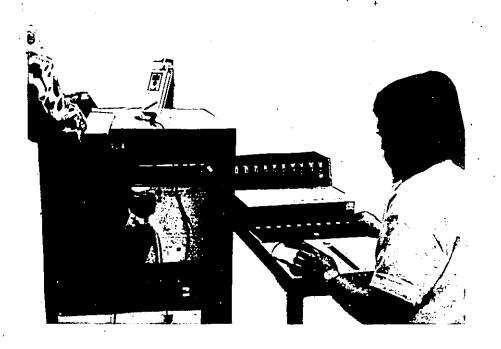


Figure 4. A subject under test.

APPENDIX B

- 1. Schematic Layout of S-R Connections.
- 2. Signal-Response Compatibility.
- 3. Why this Scheme of Connections.
- 4. Number of Performance Cycles.
- 5. Tape Preparation.
- 6. Calculations of Deviations in N_{Rj} .

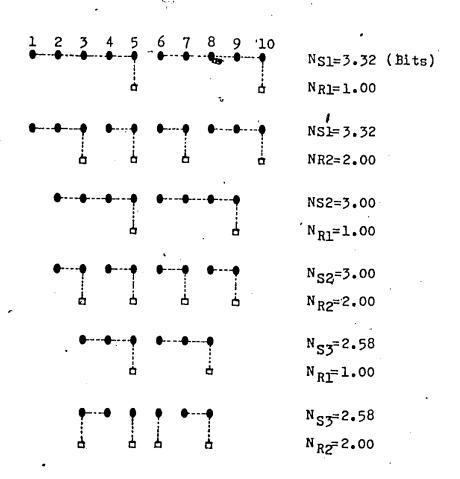


Figure 1. Schematic Layout of S-R connections representing various experimental conditions of the Pilot-Study.

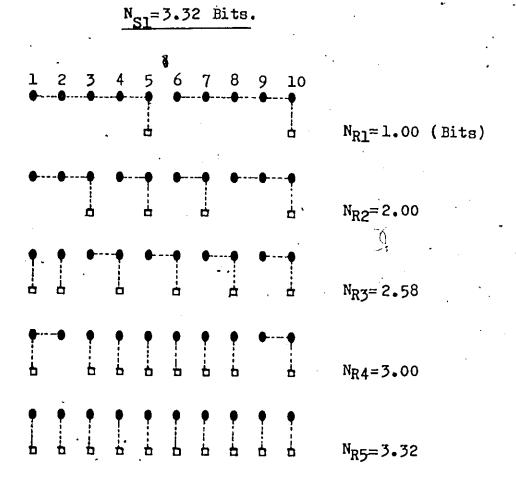


Figure 2. Schematic Layout of connections for set-1 of Major-Study.

$N_{S2}=3.00$ Bits.

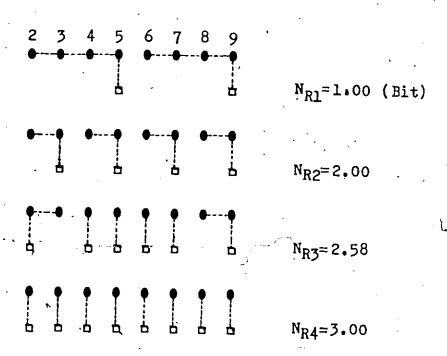


Figure 3. Schematic Layout of connections for set-2 of Major-Study.

Z

Figure 4. Schematic Layout of connections for set-3 of Major-Study.

Signal-Response (S-R') Compatibility

Signal to response compatibility plays an important role in human performance. It is obvious that if signal and response relationship is very simple, the number of errors made by the operator would be less and consequently, his efficiency in terms of performance time would be good. If this S-R' compatibility or relationship is changed, the operator is liable to commit more errors till he gets some experience on the new arrangement and the effect of compatibility with respect to any performance measure is nullified.

In the present study, this effect of compatibility was nullified by asking each subject to work on the new arrangement of each experimental condition till the experimenter felt satisfied that the effect of compatibility is no longer there.

The subject learned within 50 cycles.

Why This Scheme of Connections?

The question arises that why the scheme of signal and response connections has been like this while there can be so many other combinations. To answer this the following reasons are given:

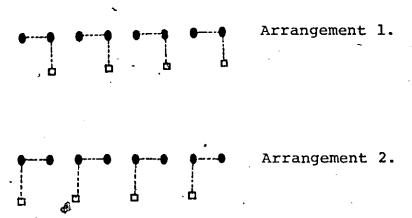
(i) R.S. #5 or R.S. #6 is always in the scheme of connections. The distance of both these switches is the same from I.B. Before the start

of the experiment it was proven in a 2 x 2 randomized, factorial experiment employing 2 subjects that the mean performance time for reach for both switches from I.B. is the same. The following table gives the mean performance times for both R.S.

Reach	Time for R.S. #5(ms)	Time for R.S. #6 (ms)
7"	270 .	272
14"	380	376

TABLE 1.

(ii) In another experiment with the given arrangements of S-R' unit, the mean performance times for reaches of 7 inches and 14 inches were also found to be the same. It was also 2 x 2 factorial experiment in which 2 subjects were employed.



Reach	Time for Arrangement l	Time for Arrangement 2
7"	574 (ms)	577
14"	605	606

Table 2.

Similarly, other combinations with the same information content in the response but different stimuli information were also tried. From these experiments, it was concluded that selection of any combination of response switches did not make any significant difference in the performance times as long as the probability of occurrence of stimuli and responses remain the same.

No. of Performance Cycles

To keep the performance cycles associated with different subsets of lights in a set in a manner that R.S. #5 or #6 is used equally, number of performance cycles were selected for each experimental condition such that the cycles pertaining to R.S. #5 or #6 were 70 for all the conditions of Pilot Study.

Similarly, for the Major Study 35 observations have been taken for each experimental condition for the purpose of analysis.

Tape Preparation

For all experimental conditions, the tapes were prepared. The probability of occurrence of stimuli in each set was kept invariant.

Calculation of Deviations in NRj

When S/R Ratio is 10/8 (see Appendix B for Connections)
Probabilities of occurrence of response no. 1 and 10

= 0.2 each.

Probabilities of occurrence of response from 2 to 8 = 0.1 each.

Therefore, information in the response, N_{Ri}

 $= -\Sigma p_i \log_2 p_i$

 $= 2 \times 0.4643 + 6 \times 0.3321$

= 2.9212 bits

Thus, % age deviation = $100 - 100 \times \frac{2.9212}{3.00} = 2.29$

When S/R Ratio is 10/6

Prob. of occurrence of responses no. 1 and 2

= 0.1 each.

%3

Prob. of occurrence of responses nos. 4,6,8,10

= 0.2 each.

Therefore, $N_{Rj} = 2 \times 0.3321 + 4 \times 0.4643$ = 2.5214 bits

Thus, % age deviation = $100 - \frac{100 \times 2.5214}{2.58} = 230$

When S/R Ratio is 10/4

1

Prob. of occurrence of responses nos. 3 and 10 = 0.3 each.

Prob. of occurrence of response nos. 5 and 7
= 0.2 each.

Therefore, $N_{Rj} = 2 \times 0.5210 + 2 \times 0.4643$ = 1.9706 bits

Thus, % age deviation = $100 - 100 \times \frac{1.9706}{2.00} = 1.50$

When S/R Ratio is 8/6

Prob. of occurrence of response nos. 2 and 9
= 0.25 each.

Prob. of occurrence of response nos. 4 to 7
= 0.125 each.

Therefore, $N_{Rj} = 2 \times 0.5 + 4 \times 0.3749 = 2.50$ bits Thus, % age deviation = $100 - 100 \times \frac{2.50}{2.58} = 3.10$

When S/R Ratio is 6/4

Prob. of occurrence of response nos. 3 and 8 = 0.333 each.

Prob. of occurrence of response nos. 5 and 6 = 0.166 each.

Therefore $N_{Rj} = 2 \times 0.5282 + 2 \times 0.4300$

= 1.9164 bits

Thus, % age deviation = $100 - 100 \times \frac{1.9164}{2.00} = 4.2$

APPENDIX C

- 1. Tables for mean values.
- 2. Calculation of E.M.S. values.
- 3. ANOVA tables.
- 4. Tests on means after experimentation.
- Calculation of variances attributable to main Aspects.
- 6. Calculation of individual variances.

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TABLE 1

PILOT STUDY - MEANS OF PERFORMANCE TIMES (MS) FOR EACH SUBJECT FOR EACH EXPERIMENTAL CONDITION

•						2 4		,	•			
		N _{S1}	$N_{S1} = 3.32$			NS2	NS2 3.00		•	$N_{S3} = 2.58$	2,58	•
_	N _{R1} =	$N_{R1} = 1.00$	$N_{R2} = 2.00$	2.00	NR1 =	$N_{R1} = 1.00^{-1}$	N _{R1} =	$N_{R1} = 2.00$	$N_{R1} = 1.00$	1.00	$N_{Rl} = 2.00$	2.00
	R ₁	R2	R ₁	R2	R	R2	R_{1}	R ₂	$^{\rm R}_{ m 1}$	R2	$^{R}_{1}$	R_2
M.W.	578.29	577.15	627.04	656.41	477.11	561.97	644.79	626.57	485.35	518.22	555.17	547.37
T.J.	368.44	396.04	490.38	499.87	365.02	398.17	452.87	485.57	342.00	344.62	430.47	420.39
G.A.	448.32	508.42 564.44	564.44	613.05	435.42	498.47	540.00	552.35	405.41	520.37	487.57	493.58
S.H.	600.67	623,28	620.83	704.84	503.71	617.92	654.24	643.80	493.44	513.72	560.67	661.04
K.A.	413.62	493.34	712.08	653.70	438.48	482.25	573.50	618.72	392.94	446.21	482.24	580.72
Means	481.86	519,63	602.96	625.57	443.95	511.75	573.00	585.20	423.83	466.63	503.22	540.60
	ì										:	

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MAJOR STUDY - MEANS OF PERFORMANCE TIMES (MS) FOR NS1 = 3.32 BITS FOR STUDY - FOR EACH SUBJECT AND FOR EACH EXPERIMENTAL CONDITION

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		,		•						
,	N La	$N_{R1} = 3.32$	NR2 =	3.00	N _{R3} =	2.58	NR4 =	2.00	NR5 =	1.00
	E E	R	ж,	R,	R	R2	R ₁	R ₂	R	R2 .
	[7	-		'	1		101	415.54	441.94
G.A.	565.59	563.97	546.82	553.05	563.34	635.77	4/1.14	10,104	r) •	
J.S.C.	651.17	695.25	676.74	683.62	628.34	654.08	597,68	678.39	500.91	548.62
M. V. R.	534.97	579.62	551.02	611.02	579.59	631.57	582.34	587.00	494.22	583.20
3	565.34	566.85	565.14	574.91	593.39	603.82	569.25	596.14	538.22	542.74
Ę.	573.31	611,34	579.79	615.25	612.28	644.77	622.88	605.22	553.34	520.82
	587.42	574.97	568.39		627.79	657.42	550.25	617.28	521.51	487.59
£ £	671 17	638.11	647.48	677.74	623.91	651.97	602.77	680.28	553.25	618.00
		743.54	602.77	633.68	609.48	653.51	613.97	603.94	567.22	645.97
, , , , , , , , , , , , , , , , , , ,		679.08	663,25	693.94	666.88	626.02	619.45	680.31	560.85	528.59
	500.02	545.14	510.25	579.02	480.45	537.97	492.14	491.22	531.08	466.88
ם מ	596.36	619.79	591.07	620.06	598.55	629.69	572.19	602.12	523.62	538.44
treatra	33.33									

TABLE 3

MAJOR STUDY - MEANS OF PERFORMANCE TIMES (MS) FOR NS2 = 3.00 BITS FOR EACH SUBJECT AND FOR EACH EXPERÎMENTAL CONDITION

				1		<i>></i> -		
	. NR1	= 3.00	.N _{R2}	= 2.58	N _{R3}	= 2.00	NR4	= 1.00
j	R ₁	R2	R	R2	R ₁	R2	R ₁	R
G.A.	547.54	607.00	578.17	571.88	560.68	588.54	385.94	453.48
J.S.C.	653.20	688.97	654.37	666.28	596.17	602.00	566.51	583.65
M.V.R.	548.34	587.91	545.48	579.05	552.39	591.71	485.31	520.22
M.W.	553.94	547.94	577.48	587.77	549.42	575.02	542.59	528.51
s. Б.	558.00	563.57	534.82	600.39	557.42	614.39	502.11	508.65
M.A.	629.85	637.82	653.51	615.48	436.04	552.94	541.97	532.68
Б.В.	669.45	685.34	636.85	697.71	654.48	679.42	565.42	595.71
M.A.K.	622.11	637.14	589.59	630.68	606.00	631.02	575.42	585.57
м.х.	675.42	624.82	656.37	640.91	629.25	650.20	513.74	539.88
T.J.	466.66	479.97	467.54	469.00	483.05	488.39	426.45	455.79
Means	592.45	00.909	589.41	602.92	563.40	597.36	510.55	530.41
						_		

TABLE 4

MAJOR STUDY - MEANS OF PERFORMANCE TIMES (MS) FOR NS3 = 2.58 BITS FOR STUDY - FOR EACH SUBJECT AND FOR EACH EXPERIMENTAL CONDITION

= 1.00	R2	414.45	584.05	535.28	511.57	495.59	506.85	627.85	591.20	570.71	416.57	525.41
N _{S3}	R_{1}	393.02	535.82	548.62	522.88	434.57	562.91	570.51	536.11	526.62	375.11	500.61
= 2.00	R_2	445.08	674.28	542.25	525.17	573.65	485.08	684.59	594.11	647.02	435.54	260.67
NS2	R_1	430.31	552.20	528.34	519.54	526.54	577.08	599.51	595.71	574.85	475.57	537.97
= 2.58	R2	501.20	706.65	524.68	521.82	512.17	516.00	708.91	603.25	607.79	437.79	564.02
NS1 =	R	446.14	554.82	518.85	509.05	524.57	565.11	643.77	600.82	550.57	416.08	532.98
		G.A.	J.S.C.	M.V.R.	м.м.	S.E.	M.A.	Б.В.	M.A.K.	м.х.	₽.Д.	Means

TABLE 5

MAJOR STUDY - MEANS OF PULSE RATE DIFFERENCES (BEAT/MIN.) FOR NS1 = 3.32 BITS AND FOR EACH SUBJECT FOR EACH EXPERIMENTAL CONDITION

PULSE RATE DIFFERENCE = PULSE RATE AT REST - PULSE RATE AT WORK

	1					-					-7
= 1.00	R ₂	80	16	12	7	11	10	12	10	11	10.77.
N _{R5}	R ₁	4	14	11	80	10	33	11	ن	12	8.55
= 2.00	R ₂	10	15	12	6	TT	16	13	80	10	11,55
N _{R4}	ж ₁	80	1.0	11	7	6	6	10	Ŋ	11	8.88
= 2.58	R2	13	15	· · · · · · · · · · · · · · · · · · ·	&	. 15	10	12	16	12	12.11
N _{R3}	R ₁	6	12	7	6	8	10		12	12	99*6
= 3.00	R2	12	13	13	11	12	20	11	16	15	99.61
N _{R2}	R1	8	∞	. 7	6	10	16	12	.13	10	10.33
= 3.32	R2	16	20	15	18	11	19	19	13	13	00.91
NRI	R _{1.5}	10	14	10	16		16	18	89	7	12.00
		09	70	7.5	84	72	100	92	75	95	
ř		M.W.	S.E.	J.S.C.	G.A.	M.V.	M.A.	M.A.K.	M.Y.	T.J.	Means

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TABLE 6

MAJOR STUDY - MEANS OF PULSE RATE DIFFERENCE (BEATS/MIN.) FOR NS2 = 3.00 BITS FOR EACH SUBJECT AND FOR EACH EXPERIMENTAL CONDITION

											
= 1.00	R ₂	100	16	∞ ·	11	01,	16	13	∞	10	11.11
NR4	R	∞	12	7	6	∞	10	10	4	10	8.99
= 2.00	R2 .	01	6	£ļ	13	11	. 91	14	œ	15	11.90
N _{R3}	R	7	Ю	æ	10	. 6	15	80	7	12	9.00
= 2.58	R ₂ .	16	13	10	14	10	, 15	. 14	14	16	13,55
N _{R2}	R ₁	6	13	, ,	11	ω	. 10	12	6	15	10.66
= 3.00	R2	- 11	15	21	21	14	14	12	9 T .	10	15.55
NRI	H H	16	13	18	16	13		11	15	∞	13.22
,	Rest	09	70	75	84	72	100	92	75	95	-
-		м.ф.	s.	J.S.C.	G.A.	M.V.	M.A.	M.A.K.	M.Y.	T.J.	Means



TABLE 7

MAJOR STUDY - MEANS OF PULSE RATE DIFFERENCES (BEATS/MIN.) FOR NS3 = 2.58 BITS FOR EACH SUBJECT AND FOR EACH EXPERIMENTAL CONDITION

		NRI	= 2.58	NR2	= 2.00	N _{R3}	= 1.00
Re	Rest	R	R2	R	R ₂	R.	R2
	09	13	1.5	ω	12	2	9
	20.	12	1.8	12	15	80	. 10
_	75	13	16	10	13	17	18
	84	. 13	16	15	17.	6	11
[~	72	11	13	10	14	ω	ω
100	0	15	18	10	13	10	ω
7	16	œ ·	11	. 6	14	<u>б</u>	Ťī
7	75	11	. 15	10	14	11	91.
6	95	20	20	13	10	10	ω
		12.90	16.00	10.77	13.55	8.99	11.22

. CALCULATION OF E.M.S. VALUES

For the proper F-test to be put in ANOVA and for the computation of variances, the calculation of expected mean squares of all the main and other interaction effects becomes essential. As a sample E.M.S. values for the experiment set $N_{\rm Sl}$ = 3.32 bits are calculated (Hicks, 1973);

Effects	Symbols	Levels	Туре
Subjects	S	10	Random
I-Reduction	· N	. 5	Fixed
Reach	R	_ 2	Fixed

	R	F	F	· /
	S	N	R.	1
Source	10	- 5	2	E.M.S.
S	1	5	2 ,	$\sigma_{\varepsilon}^{2} + 10 \phi_{S}$ $\sigma_{\varepsilon}^{2} + 2\sigma_{SN}^{2} + 20 \phi_{N}$
N	10	0	2	$\sigma_{\varepsilon}^2 + 2\sigma_{SN}^2 + 20 \phi_{N}$
SXN	. 1	0	2	$\sigma_{\varepsilon}^{2} + 2\sigma_{SN}^{2'}$
R	10	5	. 0	$ \begin{array}{cccccccccccccccccccccccccccccccccccc$
SXR	1	5	0	
NXR	10'	0	r. 0 ,	σ_{ε}^{2} + 10 ϕ_{NR} σ_{ε}^{2}
NXRXS	1	0	0	σε

TABLE 8. CALCULATION OF E.M.S. VALUES

For sets 2 and 3, the levels of $N_{\mbox{Rj}}$ are 4 and 3. Also, these E.M.S. values change for the Pulse Rate Difference Analysis because 9 subjects have been taken in all three sets of Major Study.

TABLE 9

PILOT STUDY - ANOVA FOR PERFORMANCE TIME

Source	D.F.		FR	FCR	E.M.S.	Findings
Ъ	7	60658.914			$\sigma_{\epsilon}^2 + 12\sigma_{\mathrm{P}}^2$	
ഗ	, ~	27609.267	79.83	4.46	$a_{\rm c}^2 + 4a^2_{\rm PS} + 20 \phi_{\rm S}$ S	Significant (P < 0.05)
PXS	ω	345.837		- , 	$\sigma_{\varepsilon}^2 + 4\sigma_{PS}^2$	
z	,ਜ	1318712.723	34.47	7.71	$\sigma_{\varepsilon}^2 + 6\sigma^2_{\rm PN} + 30 \phi_{\rm N}$	Significant (P < 0.05)
PXN	₹*	4024.072			$\sigma_{\epsilon}^2 + 6\sigma^2_{PN}$	
SXN	73	1711.114	1.12	4 . 46	$\sigma_{\varepsilon}^2 + 2\sigma^2_{PSN} + 10 \phi_{SN}$	Not Significant
PXSXN	∞	1528.359			$\sigma_{\epsilon}^2 + 2\sigma_{\rm PSN}^2$	
æ	ਜ	19175.943	20.32	7.71	+ 30 ¢ _R	Significant (P < 0.05)
PXR	ヤ	943,529			$\sigma_{\varepsilon}^2 + 6\sigma_{PR}^2$	
PXNXRXS	8	1537.207			σ _ε .	

P - Subjects; S - Sets; N - Information Reduction; R - Reach. Terminology:

TABLE 10

MAJOR STUDY - ANOVA FOR PERFORMANCE TIME FOR $_{\rm S1}$ = 3.32 BITS

ຶນ	4	nt 5)		nt 5)	· .	nt	2)	٦
Findings		Significant (P < 0.05)		Significant (P < 0.05)		Not Significant	(P < 0.05)	,
E.M.S.	$\sigma_{\varepsilon}^2 + 10 \phi_{S}$	$\sigma_{\varepsilon}^2 + 2\sigma^2_{SN} + 20 \phi_N$	$\frac{\sigma_{\epsilon}^2 + 2\sigma^2 \text{sn}}{\sigma_{\epsilon}}$	02 + 502 SR/F 50 OR	$\sigma_{\rm c}^2 + 5 \sigma_{\rm SR}$	$\sigma_{\rm c}^2 + 10 \phi_{\rm NR}$	0,2	3
FCR		2.65	٠٠.	5.12		2.65		
FR		13.17		30.29	,	0.31		
M.S.	21138.4285	23166.5335	1758.3396	16467.5623	543,5248	227.5040	720.3643	
D.F.	6	4	36	н	σ.	4	36	
Source	S	z	SXN	rk K	SXR	NXR	NXRXS	

Terminology (for Tables 10 - 15)

s - Subject

N - Information Reduction

R - Reach

TABLE 11

MAJOR STUDY - ANOVA FOR PERFORMANCE TIME FOR N_{S2} = 3.00 BITS

			-				
Findings		Significant (P < 0.05)		Significant (P < 0.05)		Not Significant	(P < 0.05)
E.M.S.	σ ² + 8 φ _S .	$\sigma_{\varepsilon}^2 + 2\sigma_{SN}^2 + 20 \phi_N$	$\sigma_{\epsilon}^2 + 2\sigma_{SN}^2$	$\sigma_{\varepsilon}^2 + 4\sigma_{SR}^2 + 40 \phi_{R}$	$\sigma_{\rm c}^2 + 4\sigma_{\rm SR}^2$	$\sigma_{\varepsilon}^2 + 10 \phi_{NR}$	σ 2 σ ε
FCR		2.96		5,12	-	2.96	
ř R		14.20		45.18		0.71	
M.S.	22447.1920	27312.1934	1923.22	11265.8178	249.3152	318.2543	447.8706
D.F.	σ.	, iù (,	27	Н	6	m	27
Source	ശ	Z	NXS	æ	SXR	NXR	NXRXSX

TABLE 12

MAJOR STUDY - ANOVA FOR PERFORMANCE TIME FOR N_{S3} = 2.58 BITS

Γ				<u> </u>	············		
Findings		Significant (P < 0.05)		Not Significant (P < 0.05)	•	Not Significant	
E.M.S.	σ ² + 6 φ _S	$\sigma_{\varepsilon}^2 + 2\sigma_{SN}^2 + 20 \phi_N$	$\sigma_{\varepsilon}^2 + 2\sigma_{\rm SN}^2$	$\sigma_{\rm c}^{2} + 2 \sigma_{\rm SR} + 30 \phi_{\rm R}$	σ _ε + 3 σ _{SR}	$\sigma_{\rm c}^2 + 10 \phi_{\rm NR}$	σ _ε 2
FCR		3.55		5.12		3.55	
FR		9.55		3.16		0.19	ند.
M.S.	27957.8273	8593.9845	899.1107	10284.8134 3.16	3247,4838	94.1065	485.1592
D.F.	6	8	18	-	6	71	18
Source	S	Z·	SXN	щ	SXR	NXR	NXRXS

TABLE 13

MAJOR STUDY - ANOVA FOR P.R.D. FOR N_{S1} = 3.32 BITS

	Significant (P < 0.05)		Significant (P < 0.05)		Not Significant	(P > 0.05)
$a_{\epsilon}^2 + 10 \phi_{S}$		$\sigma_{\varepsilon}^2 + 2\sigma_{SN}^2$	$\sigma_{\varepsilon}^2 + 3\sigma_{SR}^2 + 45 \phi_{R}$	$\sigma_{\rm c}^2 + 5\sigma_{\rm SR}^2$	$\sigma_{\epsilon}^2 + 9 \phi_{NR}$ /	922
	2.65		4.46		2.65	
 	3.71		46.50		1.04	-
18.62	52.10	14.03	190.67	4.10	2.56	2.46
8	4	32	H	80	4	32
χ *	z	NXS	ж 	RXS	NXR	NXRXS
	8 - 18.62	8 18.62 $\sigma_{\epsilon}^2 + 10 \phi_{\rm S}$ 4 52.10 3.71 2.65 $\sigma_{\epsilon}^2 + 2\sigma^2_{\rm SN} + 18 \phi_{\rm M}$	8 18.62 $\frac{\sigma_{\rm E}^2 + 10 \phi_{\rm S}}{4}$ 4 52.10 3.71 2.65 $\frac{\sigma_{\rm E}^2 + 2\sigma^2_{\rm SN} + 18 \phi_{\rm M}^2}{\sigma_{\rm E}^2 + 2\sigma^2_{\rm SN}}$	N 32 14.03 $\frac{\sigma_{\rm E}^2 + 10 \phi_{\rm S}}{190.67}$ 4.46 $\frac{\sigma_{\rm E}^2 + 2\sigma_{\rm SN}^2 + 18 \phi_{\rm M}^2}{\sigma_{\rm E}^2 + 2\sigma_{\rm SN}^2}$	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	$\begin{array}{cccccccccccccccccccccccccccccccccccc$

*Nine Subjects have been taken for the purpose of analysis.

TABLE 14

MAJOR STUDY - ANOVA FOR P.R.D. NOR N_{S2} = 3.00 BITS

	Γ				r c	ษำกลำกสร
Source	D.F.	M.S.	FR	FCR	E.M.3.	Shirt
	8	7.62			σ ² + 8 φ _S	
	ю	56.79	3.21	3.01	$\sigma_{\varepsilon}^2 + 2\sigma^2_{SN} + 18 \phi_N$	Significant (P < 0.05)
.	24	17.69			$\sigma_{\epsilon}^2 + 2\sigma_{SN}^2$	
•	н	138.88	56.68	5.32	$\sigma_{\rm c}^2 + 4\sigma_{\rm SR}^2 + 36 \phi_{\rm R}$	Significant (P < 0.05)
: :	ω,	2.45			$\sigma_{\rm c}^2 + 4\sigma_{\rm SR}^2$	
	m	99.0	0.25	3.01	$\sigma_{\varepsilon}^2 + 4\sigma^2$ SR	Not Significant
				•		(P > 0.05)
NXRXS	24	2.64			σ	

MAJOR STUDY - ANOVA FOR P.R.D. FOR NS3 - 2.58 BITS

D.F. M.S.	. М		ਜੂ ਲ	FCR	E.M.S.	Findings
8 21	21	21.76			σ2 + 6 φs	
2 91	91	91.12	6.18	3.63	$\sigma_{\epsilon}^2 + 2\sigma^2_{SN} + 18^{\sigma_N}$	Significant (P < 0.05)
16 1.4	1.4	14.73	·		$\sigma_{\varepsilon}^2 + 2\sigma_{SN}^2$	
1 106	106	96	106.96 23.61	4.49	$\sigma_{\rm c}^2 + 3\sigma^2_{\rm SR} + 27 \phi_{\rm R}$	Significant (P < 0.05)
16 4.	4	4.53			$\sigma_{\rm E}^2 + 3\sigma^2_{\rm SR}$	
2 0.	•	0.35	0.02	3.63	$\sigma_{\rm c}^2 + 9 \phi_{\rm NR}$	Not Significant
					·	(P > 0.05)
16 14	1.4	14.83			م 2 د	

9

TEST ON MEANS

Putting Newman-Keuls Range Test (Hicks, 1973) on the means of both studies - (for computation of means see ANOVA computer outputs).

For N_{Si} Means of Pilot Study

The means in descending order are -

557.50 526.99 483.57

2

Standard Error (SAE.) = $\sqrt{\frac{\text{error mean square}}{\text{number of observations}}}$

For a mixed model then,

$$S.E. = \sqrt{\frac{1537.207}{20}} = 8.76$$

From standard tables, for d.f. = 8, the ranges are 3.26 and 4.04.

Therefore, the Least Significant Ranges are -

L.S.R. = S.E. x Range = 28.58 35.41

1 vs 3 = 73.93 > 35.41 Significant (P < 0.05)

1 vs 2 = 30.51 > 28.58 Significant (P < 0.05)

2 vs 3 = 43.42 > 35.41 Significant (P < 0.05)

Hence all the set means are significantly different from each other.

(i) Performance Times

When $N_{S1} = 3.32$ bits

For N_{Rj} Levels

The means in descending order are -

;

3

.

614.11 608.07 605.55

587.15

2

531.02

Standard Error (S.E.) = $\sqrt{\frac{\text{error mean square}}{\text{no. of observations}}}$

$$= \sqrt{\frac{1758.3396}{20}} = 9.38$$

From standard tables, for d.f. = 36, the ranges are -

2.86 3.46 3.82

4.26

Least Significant Ranges = 26.82 32.45 35.83 39.95 Therefore,

1 vs 5 = 83.08 > 39.05 Significant (P < 0.05)

1 vs 4 = 77.05 39.05 Significant (P < 0.05)

1 vs 3 = 74.53 > 39.05 Significant (P < 0.05)

1 vs 2 = 56.13 > 39.05 Significant (P < 0.05)

2 vs 5 = 26.96 < 35.83 Not Significant (P > 0.05)

2 vs 4 = 20.92 < 35.83 Not Significant (P > 0.05)

2 vs 3 = 18.40 < 35.83 Not Significant (P > 0.05)

3 vs 5 = 8.56 < 32.45 Not Significant (P > 0.05)

3 vs 4 = 2.52 < 32.45 Not Significant (P > 0.05)

4 vs 5 = 6.04 < 26.82 Not Significant (P > 0.05)

The above results can be summed up as follows:

For R_k Levels

The means in descending order are -

2 , 1 576.35 602.01

$$S.E. = \sqrt{\frac{543.5248}{50}} = 3.30$$

for d.f. = 9, the range is -3.20

L.S.R. = 10.56

1 vs 2 - 25.66 > 10.56 Significant (P < 0.05)

When $N_{S2} = 3.00$ Bits

FSF N_{Rj} Levels

The means in descending order are

ي فلا

2 '

1

-599.24

597.66

579.93

520.48

S.E. =
$$\sqrt{\frac{1923.22}{20}}$$
 = 9.81

for d.f. = 27, the ranges are -

2.90 3.50 3.87

L.S.R. = 28.45 34.33 37.96

1 vs 4 = 78.76 > 37.96 Significant (P < 0.05)

1 vs 3 = 77.18 > 37.96 Significant (P < 0.05)

1 vs 2 = 59.35 > 37.96 Significant (P < 0.05)

2 vs 4 - 19.31 < 34.33 Not Significant (P > 0.05)

2 vs 3 = 17.73 < 34.33 Not Significant (P > 0.05)

3 vs 4 = 1.58 < 28.45 Not Significant (P > 0.05)

The above results can be summed up as follows -

N_{R1} 3.00 2.58 2.00. 1.00

For R_k Levels

The means in descending order are -

2 / 1

562.46 586.2

 $S.E. = \sqrt{\frac{249.3152}{40}} = 2.49$

1 vs 2 = 23.74 > 7.96 Significant (P < 0.05)

When $N_{S3} = 2.58$

For N_{Ri} Levels

The means in descending order are -

2

549.32 548.50 513.01

S.E. =
$$\sqrt{\frac{899.11}{20}}$$
 = 6.70

for d.f. = 18, the ranges are -

2.97 3.61

L.S.R. = 19.90 24.18

1 vs 3 = 36.31 > 24.18 Significant (P < 0.05)

L vs 2 = 35.49 > 24.18 Significant (P < 0.05)

2 vs 3 = 0.82 < 19.90 Not Significant (P > 0.05)

The above results can be summed up as follows -

N_{Rj} 2.58 2.00 2.00

The means in descending order are

2

550.03 · · 523.85

S.E. =
$$\sqrt{\frac{3247.4838}{30}}$$
 = 8.05

for d.f. = 9, the range is - 3.20

L.S.R. = 25.76

1 vs 2 = 26.18 > 25.76 Significant (P < 0.05)

(ii) Pulse Rate Differences

When $N_{cl} = 3.32$ bits

For N_{Rj} Levels

The means in descending order are

3

2

14.00

12.00 10.88 10.22

9.72

1

S.E. =
$$\sqrt{\frac{14.03}{18}} = 0.77$$

for d.f. = 32, the ranges are -

1 vs
$$5 = 4.28 > 3.15$$
 Significant (P < 0.05)

1 vs
$$4 = 3.78 > 3.15$$
 Significant (P < 0.05)

1 vs
$$3 = 3.12 < 3.15$$
 Not Significant (P > 0.05)

1 vs
$$2 = 2.00 < 3.15$$
 Not Significant (P > 0.05)

3 vs
$$5 = 1.16 < 2.67$$
 Not Significant (P > 0.05)

4 vs
$$5 = 0.50 < 2.21$$
 Not Significant (P > 0.05)

The above results can be summed up as follows -

For R_k Levels

The means in descending order are -

2 1

12.82 9.91

S.E. =
$$\sqrt{\frac{4.10}{45}} = 0.30$$

for
$$d.f. = 8$$
, the range is -3.26

$$L.S.R. = 0.97$$

1 vs 2 = 2.91 > 0.97 Significant (P < 0.05)

When $N_{S2} = 3.00$ Bits

For R_k Levels

The means in descending order are -

ļ

3

2

1

.3.94 12.11

10.55

10.22

S.E. =
$$\sqrt{\frac{17.00}{18}}$$
 = 0.95

for d.f. = 24, the ranges are -

2.92

3.53

3.90

L.S.R. = 2.80

3.38

3.70

1 vs 4 = 3.72 > 3.70

Significant (P < 0.05)

1 vs 3 = 3.39 < 3.70

Not Significant (P > 0.05)

1 vs 2 = 1.83 < 3.70

Not Significant (P > 0.05)

2 vs 4 = 1.89 < 3.38

Not Significant (P > 0.05)

2 vs 3 = 1.56 < 3.38

Not Significant (P > 0.05)

3 vs 4 = 0.33 < 2.80

Not Significant (P > 0.05)

The above results can be summed up as follows -

For R_k Levels

The means in descending order are -

1.

13.13

10.27

S.E. =
$$\sqrt{\frac{2.23}{36}}$$
 = 0.06

for d.f. = 8, the range is -3.26

L.S.R. = 0.1936

1 vs 2 = 2.86 > 0.1936 Significant (P < 0.05)

When $N_{S3} = 2.58$ Bits

For N_{Rj} Levels

The means arranged in descending order are -

3

2

1

14.44

12.16

9.94

$$S.E. = \sqrt{\frac{14.73}{18}} = 0.90$$

for d.f. = 16, the ranges are -

1 vs
$$3 = 4.50 > 3.28$$
 Significant (P < 0.05)

1 vs
$$2 = 2.28 < 3.28$$
 Not Significant (P > 0.05)

$$2 \text{ vs } 3 = 2.78 > 2.70$$
 Significant (P < 0.05)

The above results can be summed up as follows -

The means in descending order are -

S.E. =
$$\sqrt{\frac{4.53}{27}}$$
 = 0.40

for
$$d.f. = 16$$
, the range is - 3.00

$$L.S.R. = 1.20$$

$$1 \text{ ws } 2 = 2.82 > 1.20$$
 Significant (P < 0.05)

COMPUTATION OF VARIANCES ATTRIBUTABLE TO DIFFERENT FACTORS OF MAJOR STUDY

(i) For Performance Times

When $N_{S1} = 3.32$ Bits

Using mixed model, from the ANOVA table, we have -

$$\sigma_{\varepsilon}^2 = 720.36$$

$$\sigma_{\varepsilon}^2$$
 + 10 ϕ_{NR} = 227.50

$$\phi_{NR} = -49.28$$

$$\sigma_{\varepsilon}^2 + 5 \sigma_{SR}^2 = 543.52$$

$$\sigma_{\varepsilon}^{2}$$
 + 5 σ_{SR}^{2} + 50 ϕ_{R} = 16467.56

$$\phi_{R} = 318.48$$

$$\sigma_{\varepsilon}^{2} + 2 \sigma_{SN}^{2} = 1758.34$$

$$\sigma_{\varepsilon}^{2}$$
 + 2 σ_{SN}^{2} + 20 ϕ_{N} = 23166.53

$$\phi_{N} = 1070.40$$

2
 + 10 $_{S}$ = 21138.42

$$_{\rm S}$$
 = 2041.80

Total variance =
$$\sigma_{\epsilon}^2 + \phi_N + \phi_R + \phi_S + \phi_{NR}$$

= 4101.76

- % age of variance attached with $N_{Rj} = \frac{1070.40}{4101.76} = 26.00$
- % age of variance attached with $R_k = \frac{318.48}{4101.76} = 7.76$

$\underline{\text{When N}}_{S2} = 3.00 \text{ Bits}$

$$\sigma_{\varepsilon}^2 = 447.87$$

$$\sigma_{\varepsilon}^2$$
 + 10 ϕ_{NR} = 318.25

$$\phi_{NR} = -12.96$$

$$\sigma_{\varepsilon}^{2} + 4 \sigma_{SR}^{2} = 249.31$$

$$\sigma_{\varepsilon}^{2}$$
 + 4 σ_{SR}^{2} + 40 ϕ_{R} = 11265.8178

$$\phi_{R} = 275.41$$

$$\sigma_{\varepsilon}^{2} + 2 \sigma_{SN}^{2} = 1923.22$$

$$\sigma_{\varepsilon}^{2}$$
 + 2 σ_{SN}^{2} + 20 ϕ_{N} = 27312.19

$$\phi_{N} = 1269.44$$

$$\sigma_{\varepsilon}^{2} + 8 \phi_{S} = 22447.19$$

$$\phi_{S} = 2749.91$$

Total variance =
$$\sigma_{\varepsilon}^2 + \phi_{N} + \phi_{R}^2 + \phi_{S}^2 + \phi_{NR}^2$$

$$= 4729.76$$

- % age variance attached with $N_{Rj} = \frac{1269.44}{4729.76} = 26.83$
- % age variance attached with $R_k = \frac{275.41}{4729.76} = 5.82$.

When $N_{S3} = 2.58$ Bits

·5b'

$$\sigma_{\varepsilon}^2 = 485.16$$

$$\sigma_{\varepsilon}^2 + 10 \phi_{NR} = 94.10$$

$$\phi_{NR} = -39.10$$

$$\sigma_{\varepsilon}^{2} + 3 \sigma_{SR}^{2} = 3247.4838$$

$$\sigma_{\varepsilon}^{2}$$
 + 3 σ_{SR}^{2} + 30 ϕ_{R} = 10284.81

$$\phi_{R} = 234.57$$

$$\sigma_{\varepsilon}^2 + 2 \sigma_{SN}^2 = 899.11$$

$$\sigma_{\varepsilon}^{2}$$
 + 2 σ_{SN}^{2} + 20 ϕ_{N} = 8593.98

$$\phi_{N} = 384.74$$

$$\sigma_{\varepsilon}^{2} + 6 \phi_{S} = 27957.82$$

$$\phi_{S} = 4578.77$$

Total variance =
$$\sigma_{\varepsilon}^2 + \phi_{N} + \phi_{R} + \phi_{S} + \phi_{NR}$$

% age of variance attached with $N_{Rj} = \frac{384.74}{5644.14} = 6.82$

% age of variance attached with
$$R_k = \frac{234.57}{5644.14} = 4.15$$

 $\underline{\text{When N}}_{\text{Si}} = 3.32$

$$\sigma_{\varepsilon}^2 = 2.46$$

$$\sigma_{\varepsilon}^2 + 9 \phi_{NR} = 0.10$$

Therefore

$$\phi_{NR} = 0.01$$

$$\sigma_{\varepsilon}^2 + 5 \sigma_{SR}^2 = 4.10$$

$$\sigma_{\varepsilon}^{2} + 5 \sigma_{SR}^{2} + 45 \phi_{R} = 190.67$$

Therefore

$$\phi_{R} = 4.15$$

$$\sigma_{\varepsilon}^2 + 2 \sigma_{SN}^2 = 14.03$$

$$\sigma_{\varepsilon}^{2} + 2 \sigma_{SN}^{2} + 18 \phi_{N} = 52.10$$

Therefore

$$\phi_{N} = 2.11$$

$$\sigma_{\varepsilon}^2 + 10 \phi_{S} = 18.62$$

Therefore

$$\phi_{S} = 1.61$$

Therefore

Total variance =
$$\sigma_{\varepsilon}^2 + \phi_N + \phi_R + \phi_S + \phi_{NR}$$

Therefore

% of variance attached with
$$N_{Rj} = \frac{2.11}{10.34} = 20%$$

% of variance attached with
$$R_k = \frac{4.15}{10.34} = 40$$
%

When $N_{S2} = 3.00 \text{ Bits}$.

$$\phi_{NR} = \frac{0.66 - 2.64}{9} = -0.22$$

$$\phi_{R} = \frac{138.88 - 2.45}{36} = 3.78$$

$$\phi_{\text{N}} = \frac{56.79 - 17.69}{18} = 1.086$$

$$\phi_{S} = \frac{7.62 - 2.64}{8} = 0.62$$

Therefore

Total Variance = 5.706

Therefore

% variance attributed to $N_{Rj} = \frac{1.08}{5.70} = 19$ %

% variance attributed to $R_k = \frac{3.78}{6.74} = 56$ %

When $N_{c3} = 2.58$ Bits

$$\phi_{NR} = \frac{0.35 - 14.83}{9} = -1.60$$

$$\phi_{R} = \frac{91.12 - 14.73}{18} = 4.24$$

$$\phi_{S} = \frac{21.76 - 14.83}{6} = 1.15$$

Therefore

Total variance = 10.78

Therefore

% variance attributed to $N_{Rj} = \frac{4.24}{10.78} = 39$ %

% variance attributed to $R_{k} = 35\%$

COMPUTATION OF VARIANCES FOR INDIVIDUAL NRj MEANS

(i) For Performance Times

For $N_{S1} = 3.32$ Bits

Means in ascending order of Ng are -

608.07

614.11

605.55

587.15

531.02′

 $\overline{X} = 589.18$

 $s_1^2 = 356.83$

 $s_2^2 = 621.51$

 $s_3^2 = 267.97$

 $s_A^2 = 4.1209$

 $s_5^2 = 3382.58$, Total Variance = 4633.00

Therefore, % ages associated with the above means are -

7.60 13.25

5.78

0.01

73.00

For $N_{S2} = 3.00$ Bits

Means in ascending order of $N_{\mbox{Rj}}$ are -

599, 24

597.66

579.93

520.48

 $\overline{X} = 574.32$

$$s_1^2 = 621.00$$

$$s_2^2 = 544.75$$

 $s_3^2 = 31.47$

 $S_4^2 = 2898.74$, Total Variance = 4095.22

Therefore, % ages associated with above means are -

15.16 13.28 0.70 70.76

For $N_{S3} = 2.58$ Bits

548.50 549.32 513.01

 $\overline{X} = 536.94$

 $s_1^2 = 133.63$

 $s_2^2 = 153.66$

 $s_3^2 = 572.65$, Total Variance - 859.54

Therefore, % ages associated with above means are -

15.55 17.81 66.59

(ii) For P.R.D.

 $\underline{\text{For N}_{S1} = 3.32 \text{ Bits}}$

Means in ascending order of NRi are -

9.72 10.22 10.88 12.00 14.00

 $\overline{X} = 11.36$

 $s_1^2 = 2.68$

 $s_2^2 = 1.23$

$$s_3^2 = 0.23$$

$$s_4^2 = 0.41$$

$$S_5^2 = 6.97$$
, Total Variance = 11.52

Therefore, % associated with the above means are -

10.67

2.00 3.60

60.50

For $N_{S2} = 3.00$ Bits

Means in ascending order of N_{Ri} are -

1.055

12.11

14.11

$$\overline{X} = 11.75$$

$$s_1^2 = 2.34$$

$$S_2^2 = 1.44$$

$$s_3^2 = 0.13$$

$$s_4^2 = 5.57$$
, Total Variance = 9.48

Therefore, % associated with the above fleans are -

15.18

1.37

For $N_{S3} = 2.58$ Bits

Means in ascending order of $N_{\mbox{Rj}}$ are -

12.16

14.44

$$\overline{X} = 12.18$$

$$s_1^2 = 5.01$$

 $s_2^2 = 0.004$ $s_3^2 = 5.20$

Total Variance = 10.30

Therefore, % associated with above means are -

48.00 2.00 50.00 APPENDIX D

GRAPHS

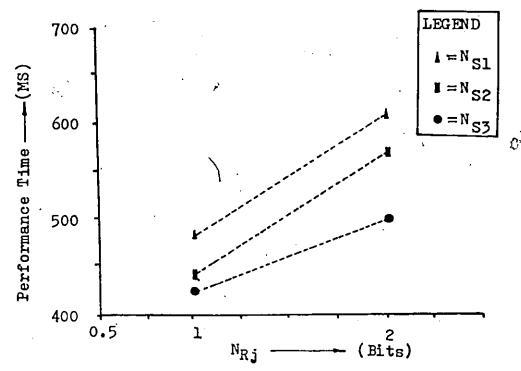


Figure 1. Results of Pilot-Study for R1

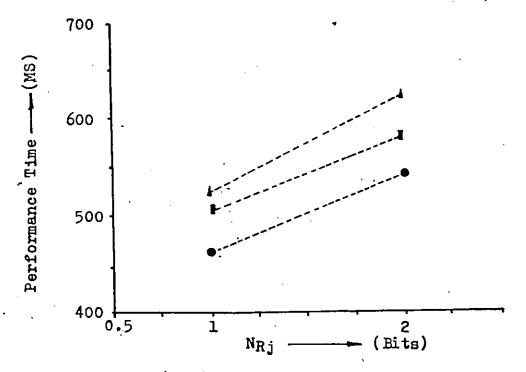


Figure 2. Results of Pilot-Study for R2

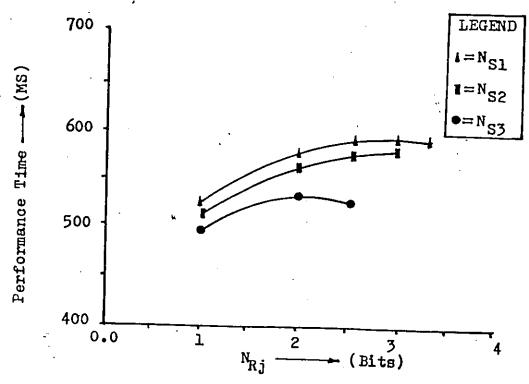


Figure 3. N_{Rj} vs. Performance Time for R₁

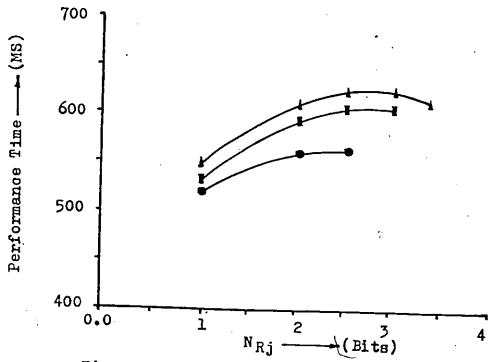


Figure 4. NRj vs. Performance Time for R2

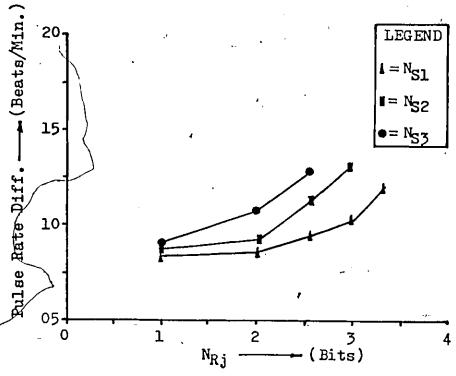


Figure 5. N_{Rj} vs. Pulse Rate Difference for R_1

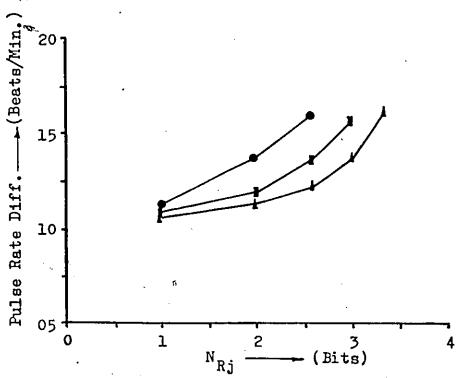


Figure 6. N_{Rj} vs. Pulse Rate Difference for R₂

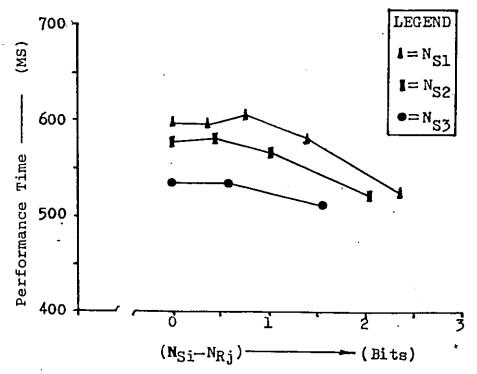


Figure 7. (Nsi-Ngj) vs. Performance Time for R1

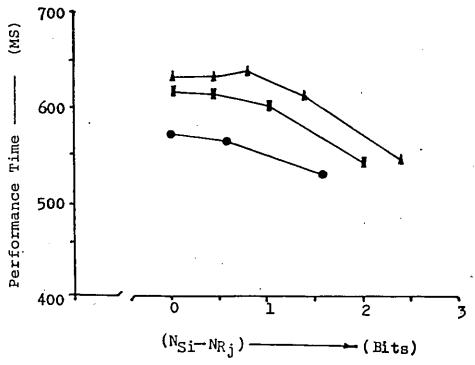


Figure 8. (Nsi-NRj) vs. Performance Time for R2

7

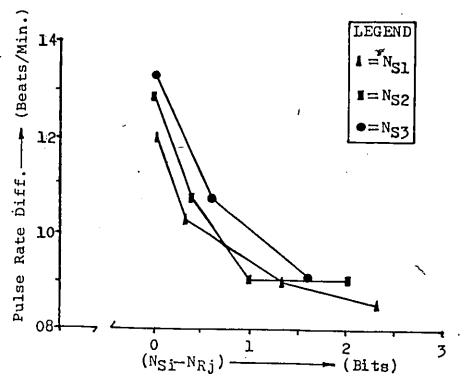


Figure 9. (NSi-NRj) vs. Pulse Rate Diff. for R1

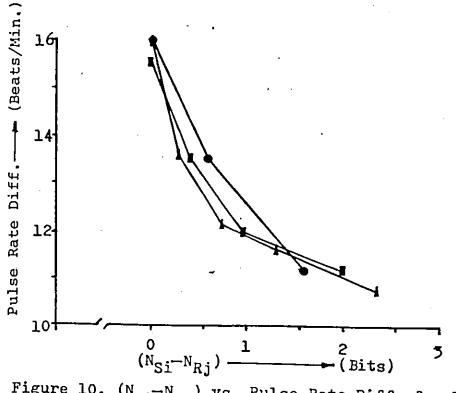


Figure 10. $(N_{Si}-N_{Rj})$ vs. Pulse Rate Diff. for R_2

APPENDIX E
REGRESSION ANALYSIS

Prediction Equations

The Regression Analysis Computer outputs indicate that the performance times for three sets of stimulus information ($N_{\rm Si}$) can be given by first and second degree equations of the nature -

$$y = a + mx$$

and

$$y = a + bx - cx^2$$

The maximum percentages of error involved in both types of curves fitting is less than 7.65%.

Based on all the first degree = ns for reach of 7 inches and 14 inches, the following equation has been developed. This = n can be used when the information in the stimulus and response has been ascertained. The = n is -

Performance Time (MS) = RAD" + CD" + 33.33 N_R

Where, RAD" = time taken in MS by the reach distance of class A

 $RA7^n = 266 MS$

RA14" = 378 MS

 N_R is the information in the response, and CD^* is experimentally determined constant (ms) based on stimulus information (bits) and reach distances (inches).

These constants are given by the following table:

N _{Si}	C7"	C,14"
3.32	230.5 (MS)	144.0
B.00	225.0	134.0
2.58	195.0	113.0

TABLE 1. Constants Associated with Different $^{N}\mathrm{Si}$ and $^{R}\mathrm{k}$ for the Performance Time.

Similarly, the pulse rate difference (P.R.D.) in beats/min. can also be represented by first and second degree equations of the nature -

$$Y = a + mx$$

$$Y = a - bx + cx^2$$

The first degree = n developed from all the = ns representing all the sets of stimuli information is given by -

P.R.D. (beats/min.) = $KD'' + 2.10 N_R$

Where, N_R is the information in the response in bits KD" is the experimentally determined constants (MS) based on stimulus information (bits) and reach distances (inches).

These constants are given by the following table:

.[N _{Si}	~K7"	K14"
	3.32	5.07	7.56
	3.00	5.97	8.51
	2.58	6.97	9.10

TABLE 2. Constants Associated with Different N_{Si} and R_k for the P.R.D.

COMPUTER OUTPUTS

Performance Times

1. For $N_{S1} = 3.32$ bits

√/ R₁

R₂

2. For $N_{S2} = 3.00$ bits

 R_1

R₂

3. For $N_{S3} = 2.58$ bits

R₁

R₂

Pulse Rate Difference

1. For $N_{S1} = 3.32$ bits

 R_1

.::

 R_2

2. For $N_{S2} = 3.00$ bits

R₁

^R2

3. For $N_{S3} = 2.58$ bits

 R_1

R.

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	PERCENT ERROR 1.5H163 -1.15190 -1.00167 0.83179	7.376884			PERCELL EBROR 0.29124 -0.63462 0.4465 -0.04992	2,808755	•	•	PERCEPT ERROR 0.00000 -0.00000 0.00000 -0.00000 0.00000	000000000		o. NUMBER OF HARMINGS=	1 SFC, HATFIV -
	R(I) F•18546 -6-78950 -5-64350 4-24755	s16 ∓		•	R(1), 1.72744 -3.77006 2.50181 -0.45919	s16 =			R(I) 0.00000 -0.00000 0.00000	= 9IS	BYTES, ARKAY AREA=	• RUP	MF = 1.01
FICIENTS . 03 62	ACY(1) 600.65546 582.63050 557.76650 514.89755	6.9ECE74	1.31	COEFFICIENTS , 345D 03 1.55F 64 038D 02	9 /CY(1) 594-17744 585-64694 565-91181 510-1908	0.997246	05.0	СОБРРІСІЕНТЯ 43-5Г СЭ 5120 02 2640 С2 7330 02	#CY(1) 592,45000 589,42000 563,41000. 510,65000	1.000000	4480	NUMBEF OF EKRORS=	1.99 SEC, EXECUTION TIME=
<pre>st studres FIT COFFFICIENTS).4 7202858899791330 03 c.42F6F45617812900P c2</pre>	Y(1) 592.45000 589.42000 563.41000	CCEFF 1C JENT =	DARD ERROR =	1PES FIT 44281234 166565621 68720108	Y(1) 592,45000 565,42000 563,41000 510,65000	SOBEFICIENT =	DIRD ERRCH =	234 1 2931 2420 3903	Y(1) 592,45000 589,45000 563,41000 510,65000	OLEPFICIENT =	DBJECT	NUMBER	
LEAST SCUA 0.47202 0.42868	X(I) <-000000 2-58000 2-58000 2-00000	COPPEL/TION	PERCENT STANDARD ERROR	LET S (1) 0.42701 1.56464 -0.13727	3.00000 3.00000 7.5000 2.0000 1.0000	CORRECATION COEFFICIENT	PEFCELL STANDIND ERRCH	LEAST SOUARES (*5-70-7177 -0-10751649 (*140-777777777777777777777777777777777777	x (1) 3.00000 2.51000 2.51000 1.0000	CORRELATION GOEFF PERCENT STANDIRD	CORE USAGE	01/64051105	Consile Time=
								•					

(1) R(1) R(1) R(1) 11.17.20 1.95.93 1.95.93 1.95.93 1.195.95 1.95.93				.•					9 BYTES 0	WEDNESDAY
\$\text{(1)} \text{R(1)} \text{R(1)} \text{R(1)} \text{R(1)} \text{R(1)} \text{R(1)} \text{R(1)} \text{R(1)} \text{R(1)} \text{R(1)}	3		1.87 PERCENT		34 PERCENT				Š	
(1)	• .	,	AVERAGE ERROR=		ER40R=	•		ERADR	FES,TOTAL AREA AVAI O, NUMBER OF	JUL 1973 VIL4
(1) R(1) (750 11.6.771 426 -3.6.355 5.15.96 5.11 (1) -1.4415 1.6.7 3.6.471 1.6.7 3.6.471		70.70		PFr CFLT ERROR 0.23788 0.44550 0.044551 0.04551	2,749170	·.	2020	00000000	H 78	
(1) (1) (1) (1) (1) (1) (1) (1)	, ,	R(1) 11.67720 -3.63574 -16.72809 9.94662		R(1) -1,44157 3,64769 -2,66136 0,45523			R(I) -0.00000, 0.00000, 0.00000		TES, ARRAY O, NURE	
"" " " " " " " " " " " " " " " " " " " "	COEFF]CIENTS 504D 03 865P 02	ACY(I) 617-17750 '599-21426 575-1411	99 E	/CY(1) 604-55/43 606-56/16 594-70864 530-878/83	0.997082	'ICIENTS 63 03 03	/CY(1) 606.00000 602.5200 597.37000 530.42000	00.0	4480 ERRORS=	EXECUTION TIP
C. S. O.	ARES FIT COEF 713292173604D 52914472486ED		SCEFFICIENT = AARD ERROR ≈ AFES F1T COFF A19374631260 0185663280170 812563280170	7(1) 606.00000 662.57000 597.37000 530.47000		RES FIT COGFF (435627659EFD 33468263009D 57643722485FD 94062058631D	Y(1) 606,00000 602,95000 597,37000 530,42000	ц п	08 Jacob NUMBER	1.96 SEC.
LEAST SCUARES FIT (0.50167132921734 (1.2872591447241724172417241739921734472417241724172417241724172417241724172	LEAST SCU 0.50167 0.3872	x(1) 3.0000 6.52000 7.5000 1.0000		2 (1) 30 (5) 5057 (0) 7 (5) 10 (0) (1)	_	1,548T_SOUA •306F8 •33665 •187465 •18383	7 (1) 3 00000 7 5 00000 7 00000 1 00000		CORE USAGE DIRCHUSTICS	COMPILE TIMES

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16 JUL 75

								59272 BYTES	٥	WEDNESDAY
•		1.38 PERCENT				0.00 PERCENT			O, NUMBER OF EXTENSIONS	9.59.58
	•	AVERAGE ERROR= 1.38 PERCENT	٠			AVERAGE ERROR= 0.00 PERCENT		5680 BYTES, TOTAL AREA AVAILABLE=		0.49 SEC, WATFIV - JUL 1973 VIL4
	PERCELL FRROR 1.30274 -2.03923 0.80432	9,611938			PERCEPT ERROR -0.00000 -0.00000	0000000			O. NUMBER OF HARMINGS=	49 SEC, WATFIV
	R(1) 6.94333 -10.97046 4.02713	= 918		∢	R(I) -0.00000 -0.00000	≈ 91s		4480 BYTES.ARRAY AREA=	0. NUM	
ų.	/CY(1) 539.92333 526.55954 504.71713	C.EC009	.83	ICIENTS 13 03 12	532,98000 537,57000 500,69000	1.000000	• 00		NUMBER OF ERRORS=	1.69 SEC.EXECUTION TIME=
20 0***********************************	Y(1) 532.98000 537.97000 500.69000	EFFICIENT =	RD ERROR = 1	LELET SCUARES FIT COEFFICIENTS 0,4053296885725755500 03 C,240C471405E690D 03 -0,2904015713662277D 02	Y(1) 532.98000 537.97000 500.69000	EFF1C1ENT =	ID ERROR = 0	oBJECT CODE=	NUMBER D	1.69 SEC.
147877776	x(1) 2.59000 2.00000	CORRELATION CCEFFICIENT =	PERCENT STANDARD ERROR = 1.83	LEAST SCUAR 0.4053294 C.12440C -0.2904015	x(1) 2.58000 2.0000 1.00000	CORRELATION CCEFFICIENT =	PERCENT STAMDARD ERROR # 0.00	CORF USAGE	DIAGNOSTICS	Cripile Tive=

SJOB WATFIV XXXXXXXXXX HERJIT SINGH SETHI.

18/20/2014/2014/2014/2014/8

							AVERAGE ERROR=		
	ı sethi.			•		PERCENT ERROR 0.79104 -1.25731 0.49252	6.176513		PURCEUT ERROR
	HFRJIT SINGH		:			R(1) 4.46170 -7.64948 2.58779	s16 =		R(1) -0.00000
/	××××××××				11CIENTS 03 02	/CY(1) 553.62052 523.62052 528.00779	. (.557403	COEFFICIENTS 0440 03 2100 02 6890 02	/CY(1) 564.03000
(WATE IV				ST SQUARES FIT CDEFFICIENTS C.EG22+EUS53120435D 03 0.2562273011897304D 02	Y(1) 564.03000 560.6600 525.42000	CREFFICIENT =	F1T 94164 37539	Y(1) 564.03000
	s JCB SENTRY			· .	LEAST SOUAR C.5022E 0.256227	. x(1) 2.55000 2.0000 1.00000	RFL/TJOP CCEFF	LEFST STUD	2.5.000

16 JUL 75 WEDNESDAY OBJECT CODE= 44f0 BYTES,4RRAY /REA= 5680 BYTES,TOTAL AREA AVAILABLE= 59272 BYTES O, NUMBER OF EXTENSIONS 9.59.16 = 0.85 PERCENT AVERAGE ERROR= 0.00 PERCENT 6-3 NUMBER OF NARITHGS= 0, NUMBER OF
6- 0-51 SEC, NATFIV = JUL 1973 VIL4 00000000 000000-0s16 = 2.02 SEC.EXECUTION IIME= CORRELATION CCEFFICIENT # 1.00C000 2.4:400 564.03000 564.03000 2.frnth 560.66000 560.660c0 1.00000 525.42000 525.42000 NUMBER OF ERRORS= PERCENT STANDARD ERROR = 0.00 COMPILE TIFE= CORF USAGE DIAGNOSTICS COPRI

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	5.47 PERCENT				1.69 PERCENT				1.08 PERCENT				0.00 PERCENT				10.09.43
•	AVERAGE ERROR=				AVERAGE ERROR=	1			AVERAGE ERROR=		•		AVERAGE ERROR*			o, filliseR OF	JUC 1973 VIL4
PERCENT ERRUR -7.26411 3.62649 5.059130 5.64207 -5.76170	0.634928			PERCENT ELACUR -2.04319 -2.04319 -3.1855 -0.18958 -1.91295 0.57955	0.244476			PERCENT ERRIG -0.617/5 -0.617/5 -1.957/8 -0.79073 -0.0857/8	0.145715			PERCENT ERROR -0.00000 -0.00000 -0.00000	00000000			ER OF MARNINGS=	1.71 SIC, PATFIV
R(1) -0.87178 0.37466 0.48873 0.50102 -0.49263	= 9IS			R(1) -0.24518 0.38381 -0.01831 -0.16967 0.04955	= 91s .			R(1) -0.07413 0.19999 -0.18574 0.07022	= 918			R(1) -0, C0000 -0, C0000 -0, C0000	s 1G =		YTES, ARKAY	C. NUNE	
/CY(I) 11.1.0.022 10.1.4.4.6 10.1.4.7.3 9.5.1.1.2 8.0.5737	6.64.4.696	5.46	ICIENTS 22 61 30	/CY(1) 11.75482 10.71281 9.64169 6.71013 8.59955	693535*3	2.47	ICIENTS 31 01 00	ACY(I) 11.92567 10.82599 9.47126 8.95022 6.54267	0.994254	1.48	C I ENTS 02 02 02 02 03 03 03 04 05	ACY(I) 12.0000 10.33000 9.6600 8.80000 6.55000	1.000000	00*3	4480	OF ERRORS=	1.97 SEC.EXECUTION TIME=
Y(1) 12.00000 10.32000 9.66000 8.86000	H H	RD ERROR = (ES FIT COEFF 8120957903D (2840537200D 5233183566D (Y(1) 12.00000 10.22000 9.66000 6.85000	EFF1C1ENT ≈		ES FIT COEFF 1544 1484950 (425776/1040 54355261370 (6976 1574610	Y(1) 12.00000 10.33000 9.66000 8.88000 E.55000	EFFICIENT =	n	15 FIT COEFF 90226208570 56863654170 63426712610 19818949920 20190665750	Y(1) 12,00000 10,33000 9,6600 8,88000 E,55.000	EFFICIENT #	11	OBJECT COU	NUMBER	1.97 SEC.
> (1) 3.32/00 2.57/00 2.55/00(0 7.67/00 1.06/00	CCFRFL/TION CC	PELTENT STANDAN	LEFS1 SCRAF 0*103920F 0*34550F 0*3465535	3.41) 3.42000 2.47000 2.450000	CEPPELATION CO	PECTENT STANDAR	1.7.37 SCUAR 0.5371854 1.55(427) -0.3359376 (.65!514)	X(1) 2.56(0 3.56(0 3.66(0 2.66(0 2.60000 1.6000	CAR VELATION COS	PEFFENT STANDE	LEAST SOUARE (*553CFC) -0.545698 -0.545691 -0.1393403 (*16(164	x(1)	CORVELATION COE	PFFFENT STANDE	CORE USAGE	DITCHCSTICS	Consile TIME=
	Y(1) /CY(1) R(1) PERCEPIT 12-00-000 11,1:3822 -0-81718 -7-264	Y(1) /CY(1) R(1) PERCEPT ERRUR 12-00000 11-1:382	/CY(1) R(1) PERCENT ERRUR 111,1382 -0.87118 -7.26441 10.1446 0.37466 3.62641 10.14373 0.46873 5.05930 0.50102 5.64207 1 8.05737 -0.49263 -5.76170 1 c.{{4666 SIG = 0.627926 AVERAGE ERRUR= 5.47	CY(I) R(I) PERCEPT ERRUR CY(I) R(I) PERCEPT ERRUR CY(I) R(I) CY(I) CY(I)	CY(1)	CY(1) (CY(1)) (10,1/476 (0,571466 (0,571466 (0,571466 (0,57173 (0,58173 (0,58173 (0,58173 (0,58173 (0,58173 (0,58173 (0,58173 (0,58173 (0,58173 (0,58173 (0,58173 (0,68	CY(I)	CY(1)	CY(I)	ACY(I) PERCENT ERRIR PERCENT ERRIR PERCENT ERRIR PERCENT ERRIR PERCENT ERRIR PERCENT ERRIR PERCENT PERCENT	CV(I)	Color Colo	1,1,1,3,2,2,2 0,1,1,4,6,5 0,1,4,6,5,5,5,6,4,9,5,5,6,6,6,6,6,6,6,6,6,6,6,6,6,6,6,6,6	11,1322 2,8113 2,8414 3,4544	10 10 10 10 10 10 10 10	1.1.1382	1,11,136,137

		•	2 BYT
. 6.22 PERCENT	2.70 PERCENT	O. OB PERCENT	# 0.00 PERCENT AVAILABLE= 59272 OF EXTENSIONS= 10.10.25 WEI
AVERAGE ERUNK	AVERAGE ERAOR=	AVERAGE ERROR=	AVERAGE ERROR YTES,TOTAL AREA 0, NUH ³ ER - JUL 1973 V1L4
PEICENT ERRUR 2,19701 2,18764 4,13159 4,43159 -6,48117 0,980553	PERCENT ERROR -2,2441 2,464 2,4520 2,1220 -4,3216 1,10439 0,412168	PFRCENT ERROR -0.04234 -0.13245 -0.13245 -0.05561 -0.00533	17 mg 00000000000000000000000000000000000
R(1) -1,21152 0,39172 0,51165 -0,69402 s16 =	R(1) -0.56711 -0.46552 0.46552 0.4932 0.11916 SIG =	KII) -0.00578 -0.01829 -0.1829 -0.01642 -0.00057	× • • • • · · · · · · · · · · · · · · ·
C E: 5 10		117 CORFFICIENTS 55780140 C1 55780140 C1 5655090 01 7(1) 7(1) 7(1) 7(1) 7(1) 7(1) 7(1) 7(1	\$\frac{2}{2}\frac{1}\frac{1}{2}\f
LEAST SCUARES FIT COFFICIENTS 0.8002106291766373D 01 x(1)	16.0000 15.0000 12.1000 12.1000 10.77000 10.77000 10.77000	AST «COURTES FIT CORFFICIENTS (1) 130/136/136/136/136/136/136/136/136/136/136	C. 9 (0.2) 746 (0.4.2) 646 (1.4.4) 646 (1.4.4) 647 (1.
LEAST SCUARES FIT COR 0.4082106291706373 0.4082106291706373 X(1) X(1) X(1) X(1) 1.50000 3.7700 3.7700 1.55000 1.00000 1.00	C.14; CC41236-1727 x (1) x (1) x (1) x 27000 3,00000 1,500000 2,00000 1,00000 1,00000 COPRELATIC: COEFFICIENT PFPCE17 : 111.0/RD ERRCR	LEAST SOUGHES FIT COEFFICE (1) 30 35 60 576 578 90 100 100 100 100 100 100 100 100 100	C. 10 (1) (2) (2) (2) (2) (2) (2) (2) (2) (2) (2

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		Roeff			RCENT	-			RCENT	:	56848 BYTES		.o. Teurisony
	.1	ଞ୍ଜ ଅନୁକ୍ଷ ଅନ୍ତ	:		R. 0.89 PERCENT				A 0.00 PERCENT		AVAILALLE=	i UF	75.04.05
		AVERAGE, ERBOR= _34.93 PERCERT	: : : :	k.	AVERAGE ERIUR=				AVERAGE ERROR=		5660 SYTES, TOTAL AREA AVAILABLE		PATEIV - JUL 1973 VIC4
	PEACEHT ERROR -6.35269 6.06050 15.19509	1,092503.		PERCENT ERROR -0.57203 1.54625 -1.21692 6.22261	c,122960			PERCENT ERROR -0.00000 -0.00000 -0.00000	00000000			=	1.03 SEC, PATFIV
	R(11) -1,10436 6,64663 1,12799 -0,72966	516 E	!	-0.05562 -0.10554 -0.10552 -0.10552	s 16 =			R(1) -0.000000 -0.000000	= 918	:	4400 BYTES, AUGAY AREA=		
OEFFICIENTS 370 01 A/1 (1	ACY(1) 12.11564 11.30403 16.1175 6.26034	6133531	= 10.44 OFFFICIENTS	13*17*39 13*17*39 10*18*648 6*8848	0.999100	71.1	009FICIENTS 130 01 300 01 100 01	# CY(I) 13.22000 10.46600 9.00000	1.000000	00.40		RUTE OF CF EARCASE	2.02 STC. EXECUTION TIMES
7.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1	Y(1) 13-2200 10-66000 5-(1000 8-99000	LEFF ICIONY :	FIT (Y(1) 13-23000 10-4500 9-6000 1-5500	EFFICIENT =	FRO ERROR =	550 7 550 7 550 7	Y(1) 13.22.000 16.66.00 9.00000 1.55.00	GPFICIENT =	ARD ERRER = '	osJECT Cabé=	ER 2:2 EE	2.02 530
LEFST SCUAPES 0.633269703 (.192769175	بالمديكاتات	CCSDCL/TICL CCEFF	PERCENT STANDARD BURD 0.1 2002525528463 -(0.1016)515555 -(0.1016)515555 0.2165762620652	3.60000 2.5566 2.00000 2.00000	COR (ELATION COEFF)	" PEFCEUT STALLARO	LEAST STUANES F (*19/5/13/5) (*17/5/16/5) (*71/1/16/5) (*71/6/5)	7(1) 3.33/30 2.57/00 2.00003 1.00003	CORTEL'TION COGFFICIENT	VITALITY TO PERCENT STANDARD	Eng∈ USige	0110001100	COMPTE TIME
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16 JUL 75

		2.76 PERCFNT					O CENCENI	
		AVERAGE ERROR= 2.76 PERCFNT				AVERAGE ERRORS		
	PERCENT ERROR -2.21932 4.20116 -1.84755				PERCENT ERRUR -0.00000 0.00000	00000000		
	R(I) -0.28637 0.45247 -0.16609	≥ 9IS			R(1) ~0.00000 0.00000 ~0.00000	516 =		
	4CY(1) 12.61363 11.22247 8.82391	0.975280	3.64	1c1ENTS 01 01	12.90000 10.77(1) 8.99000	1.000000	00.00	
0.23985597996242960 01	Y(1) 12.90000 10.77000 8.99000	CEFFICIENT =	RO ERROR =	LEAST SCUAPES FIT COEFFICIENTS 0.960/0.600495599210 01 -(-181215/0746551855: 01 0.11977302487996190 01	Y(1) 12.90000 10.77000 8.99000	EFFICIENT =	RD ERROR # 0	
0.23985	2.59000 2.69000 2.00000 1.00000	COPRELATION CCEFFICIENT =	PERCENT STANDARD ERROR = 3.64	LEAST SCUAL 0.960546 -(.18121 0.119773	x(1) 2.54000 2.0000 1.00000	CURRELATION CCEFFICIENT =	PERCENT STANDARD ERROR # 0.00	

LEAST SQUARES FIT COEFFICIENTS (.642554393654770 01

OBJECT CODE= 4480 BYTES,ARRAY AREA= 5680 BYTES,TOTAL AREA AVAILABLE= 59272 BYTES NUMBER OF ERRORS= DINGHOSTICS CCPE USAGE

WEDNESDAY 0, NUMBER OF EXTENSIONS= 1973 VIL4 10.00.40 0. NUMBER OF MAZNINGS= 0, NUMBER 0.51 SEC, NATFIY - JUL 1973 VIL4 1.56 SEC.EXECUTION TIPE=

COMPILE TITES

HARJIT STITCH SETHI.

SJOB WATFIV XXXXXXXXX

SENTRY

16 JUL 75

ME						BYTES	0	WEDNESDAY
,	AVERAGE ERROR= 2.21 PERCENT			AVERAGE ERROR= 0.00 PERCENT		5680 BYTES, TOTAL AREA AVAILABLE = 59272 BYTES	O, NUHSER OF EXTENSIONS=	10.01.08
6	AVERAGE			AVERAGE		YTES, TOTAL		- JUL 197
PEFCTUT ERROR -1,79144 -4,3452	-1,48169 0,396795	,	PERCENT ERROR -0.00000 0.00000 -0.00000	000000*0			O. NUHBER OF WARNINGS=	0.49 SEC. 12TFIV - JUL 1973 V1L4
R(1) -0.2 8663 0.452 88	-0.16625 S1G =		R(1) -0.00000 -0.00000	s 16 =		4460 BYTES.ARRAY FREA=	0. RUHB	
CIENTS 1 1 (CY(1) 15,71337 14,002F8	11.05375 C.986125	CIENTS 2 1 1	/CY(1) 16.00000 13.55000 11.22000	1.000000	00.		NUMBER OF ERRORS=	2.02 SFC, EXECUTION TIME=
S FIT COEFFIGES 7294925F 0 356293051D 0 Y(1) Y(1) 16.00000 12.55000	11.22000 FFICIENT = D ERROR'= 2.	LELST SCUARES FIT CDEFFICIENTS 0.112787642950676380 02 -(.12(44444260146050 01 0.11988214753382160 01	Y(1) 16.00000 13.55000 11.22000	FFICIENT =	D ERROR = 0.00	OBJECT CODE=	NUMBER OF	2.02 SFC.
LEAST SOUARES FIT COEFFICIENTS 0.2414626257294925F 01 0.2949123356293051D 01 7.13	1.00000 11.22000 11. COPREL/1100 CCEFFICIENT = P=02EUT STAMDARD ERROR'= 2.92	LE451 SCUARE 0.1122764 -C.1266444 0.1199821	2.55000 2.55000 2.7 CPC 1.50000	CURRELITION CCEFFICIENT =	PRRCENT STANDARD ERROR =	CLPE USLGE	OFFINISTICS	CCIFILE 111E=

SUCB WATFIV XXXXXXXXX "HIRUIT SINGH SETHI. SEMTRY

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APPENDIX F

- 1. Histograms and Frequency Distributions Charts for the Pilot Study (24 in number).
- Histograms and Frequency Distributions Charts for the Major Study (48 in number).

*Each histogram is titled.

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HISTOGRAM FOR THE CONDITION FOR SET#3, REACH=1, S.I.=3.32 BITS, R.I.=1.00 BIT.

HO. EXACT LIMITS HID-POINT F	FPEQUENCY DISTRIBUTION FORTHE CONDITION MAX MAN = 988 MINIMUM = WEAN = 481.87 IN INTERVAL 5.	18UT 10N FDR 988 7 IN 1	FORTHE CONDITION MINIMUM = IN INTERVAL 5.	FGR SET#3, REACH#1, Site#3,42 Bilds Reference Construction	717 INTERV	INTERVAL WIDTH	· · ·	о 6	·•.		: .
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REGROUPED FOR CHISO TESTS TO GIVE II INTERVALS BITHFREQUENCIES OF CHISO UNIFORM = 139.09 53 **P**3 CH159 NORMAL # 1.6408

1014.5 559.50 554.50 524.50 J 384.50 454.50 314.50 FREO

HISTOGRAM FOR THE CONDITION FOR SET=3, REACH=2, S.I.=3.32 BITS, R.I.=1.00 BIT.

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HISTOGRAM FOR THE CONDITION FOR SET=3. REACH=1. S.I.=3.32 BITS. R.I.=2.00 BITS.

F FX D FD Febers 2 0.57 10 20 200 0 0.00 9 0 0 0 1 0.29 8 8 64 1 0.29 7 7 7 2 0.57 6 12 72 3 0.66 5 11 75 14 4.00 4 56 224 18 5.14 3 54 162 22 6.29 2 44 88 50 14.29 1 50 0 106 30.29 -1 -106 106 50 14.29 -2 -100 200	MAXIMUM H 1315 MINIMUM H 354 RANGEH 961 INTERVAL MIDITH H 135.57 MEDIAN H 571.00
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	489 454.50
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REGROUPED FOR CHISO TESTS TO GIVE 8 INTERVALS WITHFREQUENCIES OF

CHISO UNIFURM = 192.03 CHISO NORMAL = 5.8580

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HISTOGRAM FOR THE CONDITION FOR SET=3, REACH=2, S.I.=3.32 BITS, R.I.=2.00 BITS.

MAX INCM =	1689	* 1571212	,	A07 RANGER	1282	INTE	INTERVAL WIDTH		3 "			
MEAN = 625.58		IN INTERVAL	· ·	ST. DVN. = 136.29	٠	MEDIAN =	e 600.00		,		•	
INT. NO.	- 1	EXACT LIMIT	1 1 90 1	MID-POINT	1 1	1 1 1 16 1	; ; ; ;; ;;		0.	F*D**2	N CON	# 1 1 1 u 1
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97	. ≛	1400 10	1469	1434,5		-	0,29	12	12	144	349	99.71
2 2	m ==	1330 TO	1399	1364.5			00.00		0	•	348	99.43
: 4	1.2	1260 TO	1329	1294.5		•	00.00	01	0	0	348	99.43
13		1190 TO	1259	1224.5	-	•	00.0	Φ.	0	0	348	99.43
12	11	1120 10	1189	1154.5		0	00.0	€0	o	0	348	99.43
1	0.4	1050 10	1119	1084.5		_	0.29	^		64	348	£ ₹ * 66
		5.80 TO	1049	1014.5		0	00.00	٠,	0	0	347	♦1.06
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4	<u> </u>	770 10	939	804.50		22	62.59	E .	99	198	330	94.29
· ·c	4	700 70	769	734.50	•	42	12.00	8	4	168	308	88.00
· •0	. •	630 TD	669	664.50		. 19	17.43		. 61	10	266	76.00
1	n	5e0 TO	653	594.50	40	1.8	23.14	0	0	0	205	58.57
, Pi	*	490 10	559	524.50	±1	97	24.86		. 18-	57	124	35.43
· N		420 T0	489	454.50	177	36	10.29	61	-72	144	37	10.57
		OT OSE	419	384.50		-	0.29	'n	6	6 1	- 0 1	0.29

> REGROUPEC FOR CHISO TESTS TO GIVE 8 INTERVALS WITHFREQUENCIES OF CHISO UNIFORM # 145.31 5 CHISQ NORMAL = 2.2626

MEAN = 873.09	1023 HINIHUM IN INTERVAL	HUM #	1023 MINIMUM = 315 RANGE= 708 INTERVAL WIDTH = 121.15 MEDIAN = 555.50	708 INTER	INTERVAL WIDTH = IAN = 555.50	• , ,	0	٠	•
INT. KO.	EXACT LIMITS	IMITS	MID-POINT	u	n M	٥	FD	F*D**2	, X
v: ••	1000 To	1049	1024.5	1 -	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	der T		1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	:
1	950 70	666	974.50	- .	62.0	o.	۰	10	350
13	900 10) (4	924.50	• (41.14	80	32	256	349
12	850 TD	668	05.478	o (00.0	^	•	0	345
	800 TO	647	824.50	a,	0.57	o	- 7	72	345
10	750 Ta	799	774.50	0 0	1.71	ĸ	30	150	343
6	7c0 1Ò	749	724.50			•	9	192	337
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HISTOGRAM FOR THE CONDITION FOR SET=2. REACH=2. S.I.=3.00 BITS. R.I.=2.00 BITS.

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HISTOGRAM FOR THE CONDITION FOR SET=2, REACH=1, S.I.=3.00 BITS, R.I.=1.00 BIT.

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CHISQ UNIFORM & 239.44 CHISO NORMAL = 12.492

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FREQUENCY DISTRIBUTION FORTHE CONDITION FOR SET=2, REACH=2, S.I.=3.00 BITS, R.I.=1.00 BIT.	659 INTERVAL WIDTH =	MEDIAN = 495.00
S.I. = 3.00	659	
REACH=2.	RANGE	ST. DVN. # 107.31
FOR SET=2	339 RANGE	ST. DVN.
FORTHE CONDITION	= MUNINIM B66	IN INTERVAL 5.
DISTRIBUTION		•
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MED-POINT.

EXACT LIMITS

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974.50	924,50	874.50	824.50	774.50	724.50	674.50	624,50	574.50	524.50	474.50	424.50	374.50	324+50
666 .	949	668	645	199	749	669	649	500	649	464	440	399	645
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 REGRCUPED FOR CHISQ TESTS TO GIVE
 9 INTERVALS WITHFREQUENCIES UF

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 CHISQ NORMAL ** 5.0638
 CHISQ UNIFORM ** 170.10

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SUMS

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R. I.=1.00 BIT BITS. HISTOGRAM FOR THE CONDITION FOR SETEI, REACH=1, S.I.= 2.58

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ON FOR SET#1, REACH#1, S.1.# 2.58 BITS, R.1.#1.00 BIT. 270 RANGE# 601 INTERVAL WIDTH # 51. DVN, # 90.805 MEDIAN # 404.00	MID-POINT	1	824.50	774.50	724.50	674.50	624.50	574.50	524.50	474.50	424,50	374.50	324.50	274.50	
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FEGEOUPED FOR CHISO TESTS TO GIVE 9 INTERVALS WITHFREQUENCIES OF 5 64 34 6 8 8 CHISO NOFMAL = 6.0257 CHISO UNIFORM = 244.26

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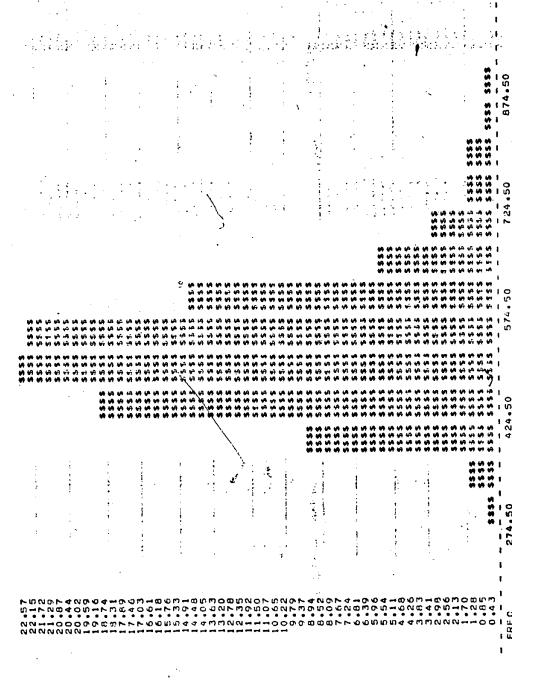
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HISTOGRAM FOR THE CONDITION FOR SET=1. REACH=2. S.I.=2.58 BITS. R.I.=1.00 BIT.

MAX IMOM =	406	HININGH .	~	259 RANGE=	849	INTERVAL WIDTH	. #	06		•	;
MEAN = 466.63	X.	IN INTERVAL 5.		ST. DVN. # 96-675		MEDIAN = 477.50					
INT. NO.	1 EX	EXACT LIMITS	1 1 1	MID-POINT	1 1	1 34 10. 1	• • • • • • • • • • • • • • • • • • •	FD	F + D + + 2	75)
4.	000	P	949	924.50		0.29) 		! = 50 !	. '0	00,000,000
· · · · · · · · · · · · · · · · · · ·	850 TO	10	669	874.50	٥	00.0	· 60	0	, 0	346	99.71
12	eco To	10	. 648	824.50		0 • 29	~	7	64	349	
1.1	750	750 TD	662	774.50		1 - 1 4	۰	84	144	348	
. 01	700 TO	10	749	724.50	0	00.0	۲n	٥	0	344	
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80	6C0 10	10	649	624.50	8)	. 62.2	m	54	72	340	
	\$50 TO	10	599	574.50	1E	8.86	N	62	124	332	
ø	500 TO	10	549	524.50	87	24.86	-	6.7	78	301	86.00
r n	450	, P	493	474.50	₩.	24.00	•	0	0	. 214	
•	400 TD		649	421,50	37	10.57	ī	-37	37	130	
m	SEU TO		399	374.50	72	7.71	2	40	108	6	26.57
N .		10	349	324.50	*	18,29	'n	-192	576	99	18.86
	250 TO		299	274.50							

REGROUPEC FOR CHISO TESTS TO GIVE BINTERVALS WITHFREQUENCIES OF 6C 27 37 84 87 31 12 6 CHISQ UNIFORM # 157.89 66 27 37 CHISO NORMAL = 1.4236

1374



R. I.=2.00 BITS. HISTOGRAM FOR THE CONDITION FOR SET=1, REACH=1, S.I.= 2.58 BITS.

FD Febres 12 7 49 12 72 20 100 33 99 34 76 51 51 64 79 -79 79 -130 260 -93 279 -16 64	· ·	1 0.29	5 1.43	36 10.29	1 28.86	0 51.43		9 68,29		339 - 96 - 96	3 98.00	7 99.14	349 99,71	350 100.00	CUX F 1 K	;		
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2	1. 1 1 1 1 1	0.29	1.14	8.36	18.57	22,57	22.29	14.57	54.8	J. 14	1.14	1.14	76.0	0.29			INTERVAL WIDTH =	TS. R.I. 2.0
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ON FOR SET#1, REACH#1, S.1.a 2.58 BITS. R.1.a2.00 BITS. 247 RANGE# 575 INTFFVAL WIDTH # St. DVN, = 90.476 MEDIAN = 493.50 MID-PGINT F F F F F F F F F F F F F F F F F F F		274.50	324.50	374.50	424.50	474.50	524,53	574,43	624.50	674.50	724,50	774.50	824.50	874.50	MID-POINT		RANGE	T#1 . REACH#1 . S
• 1 6 6 6 5 5 9 9 9 19 19 4 19 19 19	() () () () ()	299	349	. 668	449	661	549	599	649	669	749	. 662	949	569	1		287	-
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REGEDUPED FOR CHISO TESTS TO GIVE 9 INTERVALS WITHFREQUENCIES OF 5 31 65 79 78 51 19 15 7 CHISO UNIFORM = 184.14 5 31 65 CHISG NORMAL = 0.75783

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HISTOGRAM FOR THE CONDITION FOR SET*1, REACH=2, S.I.=2.58 BITS, R.I.=2.00 BITS.

20 FREQUENCY DISTRIBUTION FORTHE CONDITION FOR SET#1, REACH#2, S.I.#2.58 BITS, R.I.#2.00 BITS. INTERVAL WIDTH = MEDIAN . 522.50 852 ST. DVN. = 110.61 RANGE 335 IN INTERVAL 5. HINIM 1187 MEAN = 540.61 HAX INCH

	EXACT LIMITS	•	MID-POINT	u	FX	•	6	F +0 + •2	CUMF	M
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17	1100 TO 11	1149	1124.5		00.0	12	0	o	34.0	99.71
91	1050 TO . 38 1099	660	1074.5	1	0.29	11	11	121	34.9	99.71
13	1000 10	1049	1024.5	0	00.0	10	٥	0	348	60.43
. **	5.50 TO	666	974.50	0	00 0	o.	Ģ	0	348	99.43
13	9 00 00	646	924.50	-	0.29	€0	•			69.43
12	£50 TD 6	668	874.50	-	0 • 29		7	•		♦1.06
11	800 TO 8	649	824.50	so	1.43	w	30	160	945	98,86
D. .	750 TO 75	562	774.50	•	1.14	ın	20	100	341	97.43
٥	7 07 02 7	749	724.50	10	2.86	•	0	160	337	62.96
•	€ 50 TO 6	669	674.50	O,F	8.57	m	96	270	327	93.43
	600 TO 0	649	624.50	39	11.14	N	76,	156	297	84.86
1 0	₹50 TØ	566	574.50	35 .	10.29	1	36	. 36	25B	73,71
in in	500 TO	549	524.50	88	. 25,14	0		0	222	63.43
•	450 TO	499	474.50	. 63	18.00	7	-63	63	134	38.29
m	4 co TD 4	644	424.50	56	16.00	8	-112	224	17	20.29
, N	250 TO 3	399	374.50	13	3.71	P)	-39	117	1.5	4.29
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4EGROUPED FOR CHISO TESTS TO GIVE 9 INTERVALS WITHFREQUENCIES OF CHISG UNIFORM # 140.32 <u>*</u> 39 36 88 Đ CHISG NORMAL # 1.3294 99

HISTOGRAMS AND FREQUENCY DISTRIBUTION
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HISTOGRAM FOR THE CONDITION WHEN RFACH=1. 5.1.=3.32 BITS. P.I.=3.32 BITS.

15 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	-	IN INTERVAL 7	7. ST.	ST. DVN. # 92.641	MEDIAN = 582.50	MEDIAN = 582.50					
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	918		839	924.5A	2	0.57	60	16	128	344	98.29
	780		60.1	794.57	4	1.14	7	2 2	196	342	97.71
-	7.50		779	764.59	13	4.29	•	06	540	336	15.36
. 2	720		749	734,50	11	3.14	ĸ	W)	275	323	92.29
: =	25.6		71.0	704.50	1.7	4.85	•	6.8	272	312	A1.0A
: :	949		689	574.50	15	0.14	m	96	288	506	94.29
	P)		657	641,50	21.	7 . 71	6	ř	109	263	75.14
r- q	209		62)	614.50		10.57	-	1.0	37	236	67.43
: ^	27.5		543	584.50	4.3	13.71	0	0	o	199	56.86
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o tr	510	10	\$39	524.50	40	11.43	2-	180	091	101	28.PK
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PEGROUPED FOR CHISO TESTS TO GIVE.14 INTERVALS WITHFREQUENCIES UP CHISG UNIFICPM = 121.84 11 14 36 (FISO NORMAL = 0.47275

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5.1.=3.32 PITS, P.I.=3.32 BITS. HISTOGRAM FOR THE CONDITION WHEN REACH=2.

Tall Value of the Control of the Con

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FREGUENCY DISTRIBUTION FURTHE CONDITION WHEN REACH=2, S.I.=3.32 BITS. R.I.=3.32 RITS. MEAN = 619.79 , IN INTERVAL 8: FINIMUM # 933

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INTERVAL WIDTH =

525

ST. DVN. = 90.138 RANGF=

.,408

#HEDIAN # 605.50

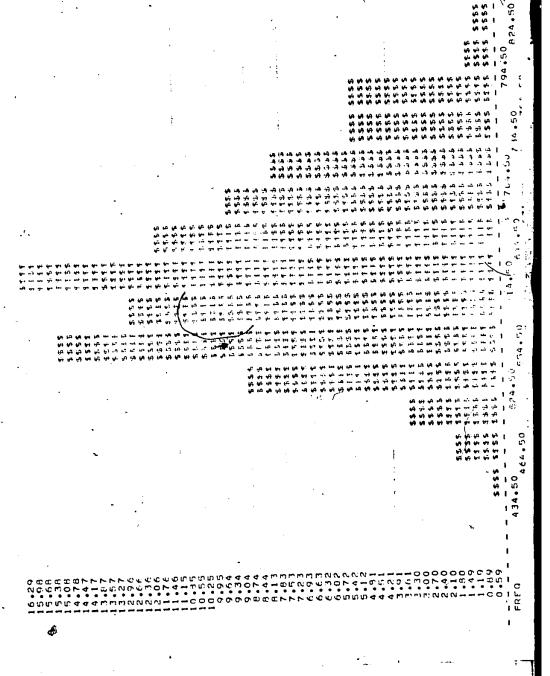
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HISTOGRAM FOR THE CONDITION WHEN PFACH=1, 5.1. #3.32 BITS, F.I. = 3.00 BITS.

POOR COPY

	MUNINIM PER	# HO	381 RANGE	453	INTERVAL MIDTH	#	30		
MEAN # 551.67	IN INTERVAL	/AL B,	51. DVN. # 85.324	¥ ED	WEDIAN = 581.50			-	
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HISTOGRAM FOR THE CONDITION WHEN PEACH=2, S.I.=3.32 PITS, R.I.=3.00 BITS.

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HISTOGRAM FOR THE CONDITION WHEN REACH=1, S.I.=3.32 RITS, R.I.=2.58 BITS.

	INT. ND.	EXACT LIMITS	. 511	VID-PEINT	L	P¢	c	Ę	F+0+62	*
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INTERVAL MISTH =

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5T. DVN. # 90.202 HANGE

IN INTERVAL . FINITCE

WEAK = 548.55 # WAIXY

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MEDIAN = 594.00

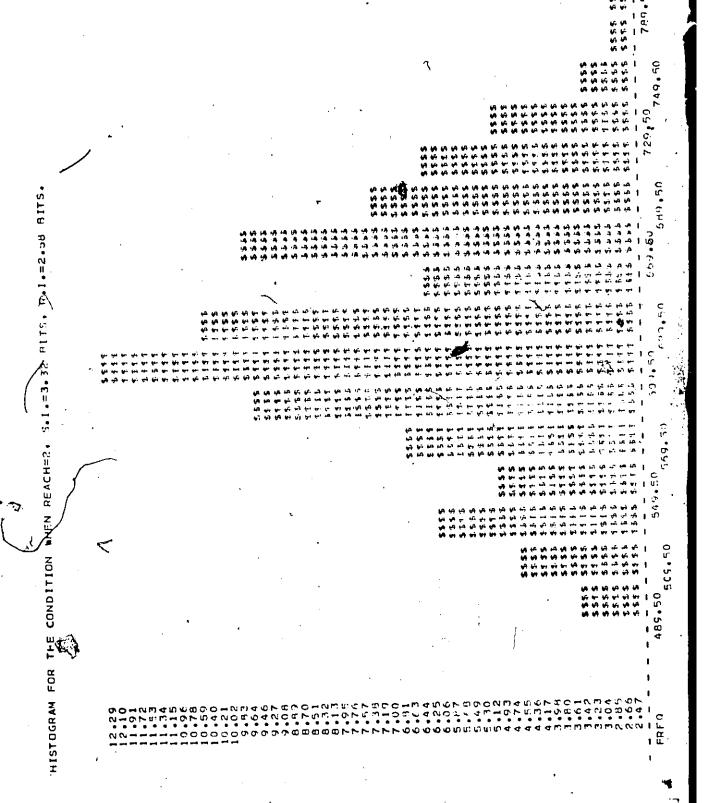
FPEQUENCY DISTRIBUTION FURTHE CONDITICY AMEN GEACHAL, S.I.=3.32 UITS. R.I.=2.FA BITS.

420

REGROUPED FOR CHISO TESTS IN GIVE 13 INTRAVALS WITHFEFOUFACIES JR 3 ₽5 6.0 4.3 m T 35 6 21 20 . FHISG NORMAL = 0.12232

12

CHISQ UNIFORM = 13743A



MAXIMUM # 75	191	797 MINIMUM A 484 RANGE= 313 INTERAL MIDTE	п	484 RANGE	313	INTERVA	INTERVAL WIDTH =	ru.	62		
MEAN # 629.69	=	IN INTERVAL	8•	5T. DVN. # 74.481		MEDIAN =	626.50				
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:	· u	E60 TO	57.0	569,50			75-3	-3	-69	702	66
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HISTOGRAM FOR THE CONDITION WHEN REACH=2, 5.1.=3.32 GITS, P.I.=2.00 BITS.

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HISTOGRAM FOR THE CONDITION WHEN REACHEL, S.I.=3.32 BITS, R.I.=2.00 BITS.

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HISTOGRAM FOR THE CONDITION WHEN REACHER, S.I. = 3, 32 PITS, R.I. = 1.00 BIT.

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TO 473 464.50 57 16.29 -2 -114 228 95.2 TO 449 434.50 23 5.57 -3 -69 707 35 1 TO 412 404.50 13 3.71 -4 -52 706 15 TO 363 374.50 4 5.57 -5 -10 - 50 2	TO 47) 464.50 57 16.292 -114 228 95 2 TO 449 434.50 23 5.57 -3 -69 207 35 1 TO 413 404.59 13 5.57 -4 -52 208 15 TO 349 374.59 11 2.71 -4 -52 208 15 TO 349 374.59 1	vs	4 PO TO	503	494.50	ą,	16.00	-	- SE	¥.	151	43.14
TO 449 434.50 23 5.57 -3 -69 707 35 1 TO 419 404.50 14 3.71 -4 -52 206 15 TO 369 374.50 4 5 6.57 -5 -10 5.6 2	TO 419 404-50 13 5.57 -3 -69 707 36 15 TO 419 404-50 13 73.71 -4 -52 208 15 TO 36.97 -5 -10 5.57 -5 -10 5.57 -5 -10 5.57 -5 -10 5.55 -10 5	•	450 TO	47)	464.50	2.5	16.29	-2	-114	22R	, 86	27.14
TO 413 404-59 15 3-71 -4 -52 208 15 TO 389 374-59 2 5 6-57 -5 -10 -5 -5 -5 -5 -5 -5 -5 -5 -5 -5 -5 -5 -5	TO 419 404-59 14 3-71 -4 -52 208 15 TO 389 374-59 2 6-57 -5 -10 50 2 2 50 2 5 50 50 50 50 50 50 50 50 50 50 50 50 5	'n	420 TO .	? *	434.50	5.3	5.57	-3	-69	207	36	10.86
TO 389 374,69 2 6,57 -5 -10 50 2	TD 389 374.69 2 6.57 -5 -10 50 2 2 2 - 10 50 2 2 2 2 - 10 50 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2		390 10	614	404.59	1.1	17.5	7	1	202	1.5	4.29
	SIJAS = 161 2055	-	360 TD	0.65	374.69	A	75.57	5 i	-10	· · · · · · · · · · · · · · · · · · ·	Ry I	0.57

HEGROUPED FOR CHISO TESTS TO GIVE 13 INTERVALS WITHFIR OUENCIES UF CHISO UNIFORM'S 162520 27 42 34 20 CHISO NORMAL = 1.2158 .15 23

HISTOGRAM FOR THE CONDITION WHEN REACH=1. 5.1.=3.39 AITS. R.1.=1.00 BIT.

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1 1011	B39 MINIMON		351 RANGHE	463	INTERVAL WIDTH =	~1	30		
523.62	Z.	7.	ST. DVM. = 70.10A	HEDI	MEDIAN = 518.00	•		•	
[MI. NO.	EXACT LIMITS		MID-PCIRT	u	. 2. 3	, c	Ę		
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	1 1 1 1 1	1 1 1	1	1 1 1 1 1 1	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	1 1 1		1 1	1
1.1	610 TO	# P	824.50	` - ,	, H. O	0	OM	300	340
91	780 10	. 40.	794.50	- '	0.29	σ	U	ï	147
15	7±0 TD	77.3	764.50	٣	0.86	Œ	\$ 2.	102	346
•	720 10	749	734.59	-	e2.0	^	~	64	343
13,	650 10	713	764.50		1.14	¢	₹2	1.4	347
S 21	660 TD	648	674.50	2	7.57	ĸ,	u) ♥	225	REF
=	(30 TO	649	544.50		1.43		50	. 80	320
10	600 10	629	614.50	22	6.20	m	e e	198	324
٥.	570 TO	543	584,50	۲.		2	56	113	305
ec.	540 TO	563	554.50	· n	14.57	_	F.	ď.	274
~	£10 TO	5 33	£24.50 4	έ¢ ,	17.00	•	.	0	216
ş	4FO TO	500	494.50		14.00	7	-63	63	160
**	450 10	479	464.50	1-74	10.PA	-5	94-	251	0.7
•	420 TO	4 0 3	434.50		6.29	m.	-87	1,76	ę,
F	390 10	÷1.	404.50	22	4.29	•	1 E	352	30
2	260 TO	383	374.50	4	1.7.1	ıçı I	06.1	150	Œ.
				,		**	-	12	^

94.30

A6.29 74.29 11.11 45.71 16.86

. REGROUPED FOR CHISO TESTS TO GIVE 13 INT-RVALS WITHFPEQUENCIES OF CHISQ UNIFICAM = 197.86 CHISO NOFWAL = 1.8012

SUMS

2489

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			**************************************	ويد کو پوټو کو پې دويو کو پې ا	
	9 9 9 V		**************************************	. एक्सक्रिक्त	
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생용하여 차 A 수 수 수 수 수 수 수 수 수 수 수 수 수 수 수 수 수 수	·	9 4 14 14 14 14 14 14 14 14 14 14 14 14 14	A-469-3-48-4-3-4-4-4	• EEFFE	
કર્યો કંઈ * કર્યો કર્યો	4 12 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4	்த்த சேசாவைக்கைக் தெழுத்தின் இதி		स्वास्त्रीस्था । रक्षाम्ब	
و الله وي الله الله الله الله الله الله الله الل					
\$1. \$2. \$41 \$41 \$45 \$45 \$45 \$45 \$45 \$45 \$45 \$45 \$45 \$45					
جب بول کون کون کی در	ات کشد بعد اکتام کاست کارو کشت شدیر کار		THE SET OF THE SET OF SET SET SET SET		•
. મું માં માં મુખ્ય સુધા યા મા મા મા મા મા મા મા મા મા	ويها الايت نها الاستشابية	جربي بوائد فوادو بوادو د	2. 14. 14. 14. 14. 14. 14. 14. 14. 14. 14	· 1 ·	
د منه التي منه التي هو هذه في هو هو هي هي هي هي هي هي هي هي هي التي هي منه التي التي التي هي منه التي التي من د التي التي ترد التي التي هي هي هي منه التي التي التي التي التي التي التي التي	يو هو هم استان الاستان الدارد. يو هو هم شاره السان الدارد		\$6. \$40 \$2. \$50 \$44 \$5. \$40 \$40 \$40 \$40 \$40 \$40 \$40 \$40 \$40 \$40	(M. 1) - 1 - 2 - 2 - 1 - 1 - 1 - 1 - 1 - 1 - 1	
و فاق فالله مدي مون مدي يوي فارد مون يا مدي اللب مدد الله عدي مدد فاقة عون	, 10 m m m m m m m m m m m m m m m m m m		در مده مده معه ولا فرد درد مده درد سالت مده مده مها ولا فرد درد درد		-,
ها کنه کید سید زد. فضد نکو هند په هند چین چین چین کنه هنه کنه هنا د	A + + + + +-	نام جاتا ہے جاتا ہوں جاتا ہوں جاتا ہوں جا خاتا ہے جاتا ہوا جاتا ہوں کے جاتا ہوا جاتا	\$4 to 60 to 10 to 10 to 10 to 10 to	;) 	
	 به ب	1 12 14 14 14 14 14 14 14 15 15 16 16 16 14 14 14 15 16 16 16 16 16 16 16 16 16 16 16 16 16	اما بنا الله الله الله الله الله الله الله ال	• ************************************	
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•	. 63.	# ## ## ## ## ## ## ## ## ## ## # ## ##	21 ft 80 ft 81 ft 81 ft 81 ft 81 8) 9) 80 ft 40 ft 81 ft 81 ft 81 80 ft 71 ft 81 ft 81 ft 41 ft 41	(마하()) 그 (() () () () () () () () () () () () () () () () () () () () () ()	:
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HISTOGRAM FOR THE CONDITION WHEN REACHET. S.I.=3.00 "115, F.I.=3.00 BITS.

MAXIMON III	758 MINIMON IN INTEGVAL	5 - U	ST. SVN. = 90.827	I G H Z	00015 = VEIDER	Ĵ		;		
IM1. NO.	FXACT LIMITS	. 118	1	ir.	1 1 37 1 (o 1	. 2 1	F + 00 + 2	CONF	ж і 1 І
	1	1 1		1 · · · · · · · · · · · · · · · · · · ·		() E	26	256	32°001 05€	3.00
1.5	750 TC	779	764450	•			1 !			3
51	720 TO	749	734,50	ır	1.43	•	in Pi	S # 2		
4	21 059	, 71.9	7.04.50	-	6 • 8'6	•	1.9	10A		97.43
4 -	640 13	6.9.3	0.74.50	2	1.7	¥n	30	150	336 96	96.57
: 2	620 10	653	404.50	10	2 ash	•	0 4	160	76 20 6	94.96
	900 10	529	614.50		7.14	m.	5.2	552		92.00
• •	£70 TO	577	6.2.4.5.3	12,	8.00	N	9	112	297 P	n αρ
,		563	661,63	4.7	13.41	-1	4.4	47	269 7	76.86
· > a) - E	, r	471.60	44.	18+34	0	1.	c •	222 6	63.43
c · 1	01.04.	, o	05.40 4	04	11.43	1	0	0.	158	45.14
	450 TC	724	र्भ व च च च		, 6.85	ri I	81-	٥.	119 3	33.71
o 4	01 02	644	434.53	e:	62*9	F	-69	401	94	26.86
n •	01 03r	413	404.0	ē.	9.14	7	-128	. 512 .	. 72 2	20.57
·	360 10	143	374.50	28	00•8	81	-140	700	1 0 1	11.43
7 6	01 011	151	344,50	6	5.57	9-	-54	324	1.2	3,43
ų -	0 F 0 F	1,2,5	000 4 4 1 F		9t.	-7	-21	147	1 F) (ě.1

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REGREUPED FOR CHISO 16515 TO GIVE 13 INTERVALS WITHFREQUENCIES OF 2.8 CHISO UNIFORM = 117,55 4 7 47 2.2 12 28 32 CHISG NOGPAL = C.47296

(3

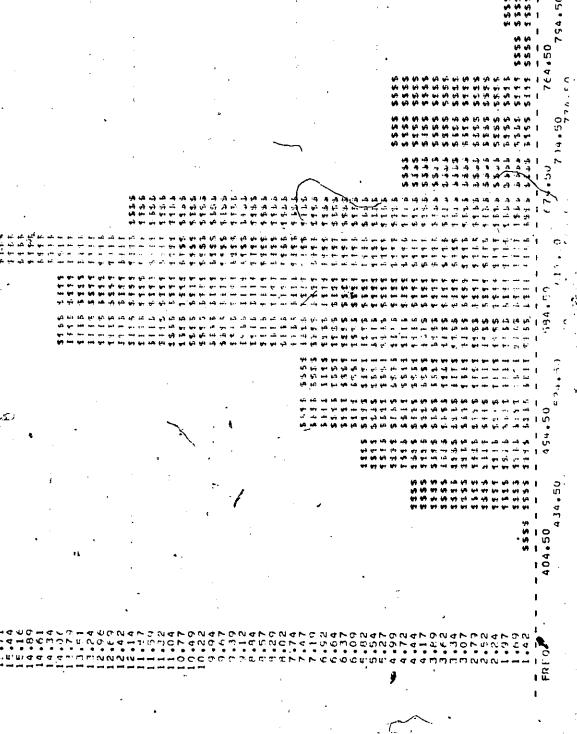
HISTOGRAM FOR THE CCNDITION WHEN REACHEZ, S.I.=3.00 4115, P.I.=3.00 BITS.

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MAXINUM =	788 MINI4U4	378	FANCES	410	INTERVAL MIDTH	n T	30		
WEAN'S 530.42	IN INTERVAL	£, ST. DV4.	0V44 = 69.471	# # #	MEETAN = \$26,00		• .	•	
INT. NO.	FXACT LIMITS		M10-FC1N1	L	щ Ж	٥	FO	F + D + + 2	CUPF
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	766 16	i I I I 00 i c	1 40 7	t -	1 0 1	1 0	1 1	1 - 0 1 - 0 1 - 1	
, •1	750 10	779	764.40	٠	0.29	• 60	• E U	. •	- U
13	320 TC	749	734.57	•	62.0		~	0 ₹	34.6
6.	£ co To .	612	7.04.07	-	5 2 2	.	1.8	104	347.
:	efc 10	68.7	674.63	^	60.5	L D	w) FT	175	344
-	620 70	655	£44.50	2.1	A HG	•	6.0	272	337
•	600 10	629	614.50	ς.	6.23	m	. 19	261	320
, -	€70 TO	593	5.64.50	4	11.71	8	e.	164	291
	540 70	563	554.50	7	14.00	-	5 🕈	64	250
ø	510 10	533	£24.50	55	15.71	0		0	201
ะก	01 094	509	424.50	64.	16.43	-1	40-	5. 5.A	144
•	AFO TO	479	464.30	Σ	15.43	۲,	-108	216	35
	420 TC	444	434,50	7.7	14.7	ĩ	1 6 -	. 243	a. m
. 2	350 TO	419	\$ 404.50	80	2.29	7	-12	128	=
1 1 1 1 1 1 1	340 70	1 T T T T T	374.50	1 1	C.F6	1 1 1 1	51-	75	1 1 1 1
٠		•				SNAS	= 73	1939	
RFGGAUPLE FOR C	REGRAUPED FOR CHISO TESTS TO GIVE 11		INTERVALS MITHFREQUENCIES OF	55 59				• ·	
11 27	주 보기 주 보기	55 49	41 29 17	•	ø		-		
CHISG NCREAL = 0.34447		E MODELAN DS HO	121.44					(ن)	



5.1.=3(00 PITS, F.1.=2.58 BITS. HISTOGRAM FOR THE CONDITION WHEN REACH=1.

زيك

FREQUENCY DISTRIBUTION FORTHE CCNDIT RAXIMUM = 795 - MINIMUM = WEAR = 559.42 IN INTERVAL 7	OUTION FORTHE CCNC 795 - MINIMUM IN INTERVAL	NDITION WH!	CN WHEH REACH=1, 5,1,=3,00	00 dlTS, R.1.=2. 40.3 plffq Median =	.1.=2.58 PITS. INTCAVAL WIOTH IAN # 592-50	, es	and		` '	
INT. NO.	EXACT LIMITS	175	VID-PC181	L.	ž	c ,	G I	F*D**2	7 C C	١ ٠٠
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1	1 1 t 1	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	1 1 1 1	 	 	 	; ; ; ;		6
<u> </u>	720 10	60°	754.50	7.	00.3		4	7 # 7	-	20.001 165
	750 TO	179	744.50	ø	1.71	¢	96	214		48.00
12	720 10	749	714.50	1.7	, 86	s.	æ; œ	4 25	337	96.29
1 =	653 70	719	704.50	17	4 . 455	•	£ 9	272	320	91.43
	ero ro	689	674.50	16	25.2	m	d i	144	303	86.57
	620 10	659	644.50	4 2	17.00	CZ	•	168	287	92.00
· or	650 10	629	514.50	53	14.71	-	ur ur	e G	245	10.00
, .	670 TD	455	5,94,50	6.	76.00	۰,	v	c	061	54.29
. •	540 TC	569	554,50	6	13.60	7	64-	. 0 4	141	40.29
ı មា	510 TO	53.3	624.50	26	7.43	2 -	2 × 1	1 0	92	26.29
	4 EG TO	503	404,50	26	F 4. 7	F)	-78	234	ť	13.86
· F.	450 10	479	464,510	20	17.5	, 4	-80	320	<u>ن</u>	11.43
, P	420 TD	643	434.50	1.5	4.20	ı,	£4-	375	20	5.71
	350 TO	010	404.50	5	1.43	91	-30	1 1 1 1 1 1	-n i	7-1
	1 1 1 1 1 1 1	1 1 1 1	, , , , , , , , , , , , , , , , , , ,	1 1 1 3		07,12	,	7. E. T.		

· CHISG NORMAL # 0.17667

CHISG UNIFORM = 150.48

HISTOGRAM FOR THE CONDITION WHEN REACH=2, S.I.=13.00 01T5, F.I.=2.58 BITS. 434.50 0 .4 FRE 0

= MONIXY#.	BOS MINIMUM =		ALS CANTES	352	INTERVAL MIDTH	•	30		
MGAN # 605.92	IN INTERVAL	•	5T. DVI. = 03.723 F	•	NEC14N = 610.50	.,	,		
1NT. NO.	EXACT LIMITS	115	· UID-FCINT	i.	H H	c	ű	Febes2	Ċ
t t t t t	1 1 1 1 1 1	1 t t	1 1 1 1 1 1 1 1 1 1 1	•	1 6 1 6 1 6 1 6 1 6 1 6 1 6 1 6 1 6 1 6	! ! !	1 1 1	1 	! !
4	7E0 TO	0 0 0	794.57	₫	1.14	vo	24,	144	350
	150 TO	779	764.50	11	3.14	S	N E	275	346
. 21	720 10	641	734.67	13	3.71	•	er P	208	335
- =	650 10	713	704.50	, ş;	7.43	P [*]	47	2,34	322
01	66C TO	683	674.50	/\\\\	11.43	N	80	160	25F
	630 70	659	644.50	37	10.57	-	37	37	254
ď	600 10	629	6.10.50	70	20.00	0	o	o	219
	570 TO	705	(2,14,	0.4	11.43	7	9	04	149
. •	£40 TO	56.1	4.54.50	15	10.00	-2	-70	140	1 19
sri	£10 TO	533	524.50	2.2	6.29	F.	-66	861	1.
<i>Y</i> .	480 10	533	494.50	20	5.71	†	. 3g-	320	52
en	450 .10	47.9	464.53	:	. [443	ر د	¥7 0	475	3.5
• ~	420 10	. *	. C3.4E4	12	3.43	ę	-72	414	~
,		•	40	•	100	-7	•	64.	

REGGOUPED FOR CHISO TESTS TO GIVE 12 INTGRVALS WITHEREOURNOISS WE ĆH150 UNIFURM = 101.42 25 CHISG NOFFAL # 0.31457

42.57 73.14

3.71

2712

-104

SU4S

3.14

31.14 21.14 14.86

00.56 95.71 P4.57

99.66

100.00

HISTOGRAM FOR THE CONDITION WHEN REACH=1, 3.1.=3.00 PITS, P.1.=2.00 BITS.

FFAN H SELLOAL	IN INTERVAL	2VAL 7.	FAN 3 562.41 IN INTERVAL 7. 8T. DVII. 2 90.37 F MEDIAL 2 561.00	304 INTER WEGIAN =	INTFFVAL WIDTH		0 m	••	
\ \\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\				ِن ن		Æ			
•	FXACT L	(ACT LIMITS	MIN-OCINT) 14 	й. 1) °	, O4	4 F # D # + 2	CUN
. 61	870 TC	77 R		l I	1 1 1 1		1 1 1 1 1		1 1 1 1
1.1	640 TO	C)		-	0.29	Ξ	11	121	356 100.00
. 91	810 TO	639	324.40	r u i	0.57	10	20	200	349 99471
	783 TO	40)	794.40		00.0	6	9	٥	
-	750 10	773	764.50	et r	4.14	œ	32	256	347 39.14
=	720 10	743	734.50	- (0.85	^		147	343 98,00
7 ₹ 1	650 TO	719	704.50	r :	1.43	c	30	150	346 27.14
-	or 🖏	669	674,50	``.	J. 4 3	en	99	950	315 95.7
9	620 10	454	0	7	e P	•	7.6	304	323 92.20
~	600 TO	623	614.40	£ ;	10.00	m	105	315	304 96.46
er	. 570 TO	500	564.50	<u> </u>	41.6	∾.	•	. 126	269 76.96
~ ·	540 TO	56 1	654.59	· .	* ;	-	δE	66	237 47.71
·c i	£10 TO	53.1	524.50	i .	08.4	•	0	ю	178 56.57
ın	480 10	500	4 54.50		E 4 - 7 - 7 - 7 - 7 - 7 - 7 - 7 - 7 - 7 -	ī	-47	٠,	146 41.7
• 1	. €0 €	479	464.50	, , <u>a</u>	00.	2	80-	196	99 28.29
n .	420 10	44.3	4 14.50	: •	*1.0	7	₹G.	162	50 14.29
N	290 10	41.3	0.14 .5.9	<u>.</u> -	. 00	7	-56	224	32 9.14
, , , , , , , , , , , , , , , , , , ,	360 TO	34.3	374.50	٠ ب -	9.86	ış.	-13	75	1H 5.14
•) 		1111111111	1 1 1 1 1	4.29	٩	06-	540	18 4.30

REGROUPPE FOR CHISQ 1CSTS TO GIVE 13 INTCOVALS WITHFREQUENCIES JE 15 17 18 49 47 52 39 32 35 17 CHISG NORMAL = 0.63384 CHISG UNIFCEM = 115.77

RAN FOR THE CONDITION WHEN REACHER, S.I.=3.00 BITS, R.I.=2.00 BITS

FREQUENCY DISTRIBUTION ROOTHS	OCS NOT I	THE COMPLETE	0 C C C C C C C C C C C C C C C C C C C	0	5	() () () () () () () () () ()		1	_		
HANIMUM =	H27	5	SATUR MERCHANA COLLOS DELOS COLLABORADOS MILOS SATURAS	744	1 1 2 1 C	*INTERVAL MIDIE			-		
MEAN = 557.37	-	90	ž		# Y # 1 11 3 %	034-E		2	.•		
,				4							
INT. NO.	EXA	EXACT LEMITS	MIO-PEINT		L	y v	c	FD	F+0**2	a D	1 H
f f f J 1	1 1 1 1	1 1 1 1 1	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1	1	1 1 1 1 1 1 1 1	1 1 1	1 1 1	. 1	1 1	1 1 1 1
. 16	810 TB	TO 01	824.50	•	-	66.3	Đ		49	356	356 100,00
1.5	7£3 TO	TO 803	794.50		່ ທ	1.43	^	E.	245	349	99.71
7.	750 10	57.7	764.50		ď	1.71	٠	9F	216	344	98.20
FT	720 10	TO 74.7	734,50		13	1.71	ស	Α. Rb	325	A.E.	46.57
12	650 TB	TO 711	7.04.50	ı	2.3	4.57	•	92	36 A	325	92.85
==	640	TO 683	674.50		36	10.29	n	10e	324	302	86.29
01	636	10 559	3 634 FO		40	11.43	8	90	140	266	24.00
c	F C 3 1	10 629	£ \$ 4 .50		50	14.23		50	9	226	64.57
נד	£76 1	10 599	5.24 + 50		4	12.57	0	v	c	174	F0.29
	. 540 TO	TO 563	554.50	•	4.3	12.27	7-	.43	F	1 32	37,71
•	£10 TD	TD 539	524.50		15	10.00	-2	27.	140	٠ د	25.43
in	4 E 0 T D	TD 509	494.50		25	7.43	ŗ	- 7 B	45.5	54	15.43
•	450 TO	TO 47-9	464.50		13	5.14	4	-72	288	2.E	9.00
•	420 70	10 140	434.50		8	6.29	ę,	0 4 0	. 200	10	2.86
2	350 TC	7.5 419	404.50		-	0.29	ç	ų 1	٩٢	2	0.57
- 1	360 1	486 01	374.50		-	00.0	-7	-7	6	-	0.29
	: ') } ! !	1 1	1 t 1 1	1 1 1	 	1 1 1 1 1 1	l - ‡	1 1 1 1

2142

15.0

SUMS

REGROUPED FOR CHISO TESTS TO GIVE 13 INTERVALS WITHFPEDDENCIES OF 36 CHISC UNIFORM = 105.97 40 20 4 **~** 5 35 CHISC NORMAL = 0.15988 18

704.50 HISTOGRAM FOR THE CONDITION WHEN REACH=1. S.I.=3.00 HITS, F.I.=1.30 HIT. 914.50 581.50 5,94°F9 4 14.50 404.50 314.50 1 2 2 2 2

344.50

	30	
FREQUENCY DISTRIBUTION FORTHE CONDITION WHEN REACHEL, S.L. = 3.00 BITS, R.L. = 3.00 BITS.	481 INTERVAL MIDTH =	WEG 1AN = 594.50
00 dtTS	1 A 4	
REACH=1, S.1.=2.	391 RANGE=	100-100 E 14AC
HON.	391	5.T.
FORTPE CONDITION 1	F BORIVIA	IN INTERVAL 7. ST. DVN. = 70.703
NOI I	8.72	-
FREQUENCY DISTAIN	= MACINA	#EAN = 592,45

INT. MO.	EXACT LIMITS	15	WID-PCINT	u -	ï,	٥	G.	F = D = = 2	CUMF	,
1 1 1 1 1 1 1	t ! ! ! !	1 1 1 1 1	1 1 1 1 1 1 1 1 1 1 1	1 1 1 1	 	! ! ! - !		1 1 1 1 1 1 1		4 1 1
21 .	670 TO	668	864.57	-	02.0	, 40°	2	100	1360	350 100.00
16	840 TO	869	854+50	0	0.09	״	0	0	349	99.71
¥;	£10 TC	639	824.50		00.0	æ	0	0	340	99.71
۲.	7E0 TO	409	794.50	4	1.14	7	28	196	349	93.71
1.1	750 TO	622	764.50	¢	2.57	•	4	324	345	49.57
112	720 10	743	734.50	1.3	3.71	ĸ	90	325		00.96
=	650 10	719	704.50	25	7.14	•	100	• • •	323	92.29
10	660 TO	683	674.50	• •	11.43	m	120	340		85.14
	630 TO	559	644.50	31		~	29	124		73,71
.	eco TO	629	614.50	4.7	13.43		. 47	4.7		64.86
-	£70 TO	597	584,50	36	10.29		ပ	o		51.43
•	£40 TO	56.3	554.50	34	10.65	7	- 3e .	3.8	144	41.14
· ·	2510 TO	531	524.50	37	10.57	2	-74	148	104	30.29
•	440 TD	507	494.50	23	6.57	-	59-	1 207	69	19.71.
-,	450 TO	479	464.50	2 3	6.57	4	-92	36.8	÷	13.14
2	420 TO	443	434.50	11	4.86	5	۲0 ف ا	424	23	4.57
	350 TO	410	404+50	1 4 1	1.71	1 1 1 1	-36	216	1 0 (1 0)	1.71
•						SUMS	92	3278))) ₁ .

 REGROUPED FOR CHISO TESTS TO GIVE 14 INTERVALS WITHFREQUENCIES OF

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 17
 22
 23
 37
 34
 45
 31
 40
 3

 CPIEC NORWAL = 0.48577
 CHISO UNIFCEM = 96.AE0

Program B

HISTOGRAM FOR THE CONDITION WHEN REACH=2. S.I.=3.00 BITS. P.I.=1.00 BIT.

	20		D FD FeDee
			1 C 1
FREGUENCY DISTRIBUTION FORTHE CENDITIEN WHEN REACH=2: \$:1.=3.00 UITS: B:1.=2.00_FITS.	d20 INTERAL MIDTH =	4661AN = 611.00	* · · · · · · · · · · · · · · · · · · ·
00 0115	J20	,	1 1
EACH=2, 5.1, 5.3,	417 BANGE=	VN. = FB.679	MID-PCINT
B MEN	417	9T. D	1
FURTHE CCN0111CN	MINIMUM	IN INTERVAL 5, ST. DVN. T FB.679	NI. NU. EXACT LIMITS MID-PCINT F \ FX
DISTRIBUTION	в 1237		! ! !
PREDUENCY	RAXIVUM S	WEAN = FCE.79	HMT. NO.

 . « ທ	,	607	1224.5	-	62.3	2	7	8 1		
· un		1193	1174.5	0	00.0	1.1	o	0	349	99.71
		1147	1124.5	0	00.3	10		0	346	99.71
4		1099	1074.5	.0	0.00	σ.	0	0	349	99.71
		1049	1024.5	0	0.00	œ:	υ	0	346	99.71
		666	974.50	0	00.0		U	.	340	12.60
. =		949	924.50	0	00.0	v	U .	• .	340	
	£50 TO	(uB	874.50	•	٥٠٠٥	s vi		0	Ø ₹	99.71
	800 10	649	924.50	0	03.0	4	0	0	345	
		199	774.50	91	4.57	n.	8.8	144	₽ • • • • • • • • • • • • • • • • • • •	49.71
	700 10	74.1	774.50	28	6.00	. 62	98	112	333	95.14
		(59	674,50	₽, \	14.29	-	20	220	30	
, u		64.1	621.50	102	29.14	0	U	0	254	
	650 TO	661	574.50	8	15.43	7	40.	54	153	
		547	524,50	51	14.57	-5	-102	204	6	
- 12	4 5 0 10	4.7.1	474,50	44	12.57	n.	-132	356	₫ ◀	13.71
	460 10	443	424.50	•	1.14	41	116	1 21 1	∢ 1	

REGROUPED FOR CHISO 1ESTS TO GIVE 7 INTERVALS NITHFFEQUENCIES JF 46 E1 E4 102 50 28 17 CHISG UNIFCRW = ES.240 CHISG NCRWAL = 0.19514

	•					1 8 8 8 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9
· ·					(A)	• 1 866 • 1
		•		* * * * * * * * * * * * * * * * * * *		**************************************
•	;			**************************************		4 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
		அவைவைவை செ		*************	ன வின் அமை வின் இடி வின் அமி நடிக்கி நடிக்கி கொடிக்கி இந்த இடிக்கி வின் அன் ஆ இந்த இதி வின் வின் வின் வின் நடிக்கி வின் வின் வின் வின் வின்	14 44 44 44 44 44 44 44 44 44
نو يو دو غو در مر شرعو	en en en en en en	راه به	· · · · · · · · · · · · · · · · · · ·		4. ** ** ** ** ** ** ** ** ** ** ** ** **	- को की के का छ भुम्भुक्षेत्र कि
******	A B B B B B B B B B B B B B B B B B B B	تيد نظ قدم نمد نما ان دي سيد دي ناي دي دو دي ديد دي دي دي دي ري دا ديد اند ان دي دي دي دي دي وي دي		報告でする。 かん ちゅうか 動物を かかし かべ し		- Martin Andrew 17 (2) (2) (2) (2) (2) (2) (2) (2) (2) (2)
,		يه سو کړ سو کړو مو سو چه هم هو کو هم هي هم هم		\$P\$		# No HE TO 1 1/2 1/2 1/2 1/2 1/2 1/2 1/2 1/2 1/2 1
	•	جم جم بھ جم جم جم جم جم جم جم جم	医眼状性 化二甲二甲二甲二甲二甲二甲甲甲甲甲甲甲甲甲甲甲甲甲甲甲甲甲甲甲甲甲甲甲甲甲甲	· "我就是我们的"我们",我们就是我们的"我们"。 "我就会会会会会会会会会会会会会会会会会会会会会会会会会会会会会会会会会会会会		**************************************
		3 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4	**************************************	**************************************		स्थानक विकास का स्थान स्थानक विकास का
	` \	· • • • • • • • •		у барычания Финттий	한 환 차 차 가 맛 맛 맛 다 다 다 다 가 가 다 다 다 가 가 차 차 차 차 가 하 다 다 다 다 다 다 다 다 다 가 다 다 다 다 다 다 당 맛 맛 맛 맛 맛 맛 맛 맛 맛 맛	പ്രാധിക്കുന്നു. എവിക്കുന്നു. എവിക്കുന്നു.
•	1		;	*	* * * * * * * * * * * * * * * * * * *	4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4
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4		: :		e.		, E
		• • • • • • •	4.00-24.0001	ທີ່ເພື້ອ ກັດ ລ້ອ ໝີ ຄົນລັດ		とりてもくし

HISTOGRAM FOR THE CONDITION WHEN PEACH=1. S.I.=2.59 FITS, R.I.=2.58 BITS.

15 15 15 15 15 15 15 15		TION FORTHE CONDI- 789 MINIMUM = IN INTERVAL	101110H	FREQUENCY DISTRIBUTION FORTHE CONDITION WHEN REACH=1, S.11.=2.58 BITS. HAXIMUM = 789 KINIMUM = 342 DANGE= 447 INTERVAL WIDTH WEAR = 512.99 IN INTERVAL 7, ST. DVN. = AB.563 HEDIAN = 534.00	53 BITS	INTERVATORIAN =	.1.=2.58 BITS. INTERVAL WIDTH # IIAN = 534.00	.	30	
750 TO 409 T72,50 1 0.29 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9	٠,٢٨	EXACT LIMI	. 51	MID-PCINT		! ! !			5 1	2 1 8 4 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
750 T0	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	1	1 1 1	1	i (l I				;
750 TO 779 764.50 2 0.55 8 16 12 720 TO 779 774.50 3 0.96 7 21 10 650 TO 713 704.50 674.50 19 5.43 5 45 21 6.00 4 64 5 4 64 3 2 6.00 4 64 3 6 65 4 65 4 65 4 65 4 65 4 65 4 65 4 65 4 65 4 65 4 65 4 65 4 65 4 65 4 65 4 65 4 65 4 65 4 65 4 65 7 7 11 4 7 11 4 11 4 11 4 11 4 11 4 11 4 11 4 11 4 11 4			,	05.407		_	0.29	c	G.	.
779	•	7.FO TO	r r			^	0.57	É	16	128
741 73450 3 11	v.	750 TO	119	00.001			48.0	۲-	21	147
713 704.40 6 14/1 6 4 4 4 5.43 6 7 7 7 7 7 7 7 7 7 7 7 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 9 9 8 8 8 8 8 8 8 8 8 8 8 8 8 9 9 9 9 9 9 8 9 9 8 9 9 8 9 9 8 9 9 9 8 9 9 9 9 9 9 9 9 9		720 TO	740	734.50		•			9	216
EAT 674-67 19 5-43 5 4 64 3 4 64 3 4 64 3 64 3 64 3 64 3 64 3 64 3 64 3 64 3 64 3 64 3 64 3 64 3 64		650 TD	713	704.50		c	1.*!	י פ	? u	475
n51 644.50 21 6.00 4 84 2 84 <t< td=""><td></td><td>01.044</td><td>1.6.4</td><td>674.50</td><td></td><td>61</td><td>5.43</td><td>ស</td><td>n -</td><td></td></t<>		01.044	1.6.4	674.50		61	5.43	ស	n -	
6 6 7 6 14 4 5 0 33 9 4 3 3 9 9 8 2 2 7 4 1 1 4 7 1 1 3 4 3 1 1 4 7 1 1 3 4 3 1 1 4 7 1 1 3 4 3 1 1 4 7 1 1 3 1 1 1 4 7 1 1 3 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1			4	CF. 447	•	21	٧.00	•	¥	666
517 584.50 - 37, 10.57 2 74 1 54.1 554.50 47 13.43 1 47 53.1 524.50 - 36 10.29 0 0 0 53.1 524.50 - 36 10.29 0 0 0 470 464.51 33 0.43 -1 -33 470 464.51 - 35 10.00 -2 -70 1 470 464.50 37 10.57 -3 -111 3 417 404.50 8 2.29 -6 -40 2	_	61 065 61 065	9,	614.50		33	9.43	m	66	29.5
517 584.50 47 13.43 1 47 57.50 5.10 6 6 6 7.10 6.20 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		600 10	:		i	47	. 10.57	N	. 74	
5.11 554.50		570 TB	らい	D			17.43	_	4.7	47
5.11 524.50 35 1912.7 -1 -33 501 494.57 33 0.43 -1 -33 470 464.51 35 10.00 -2 -70 1 6.10 7 10.57 -3 -111 3 6.10 374.50 8 2.29 -5 -40 2		540 TO	44.5	ሊ ተ ተ ተ ተ ተ ተ ተ ተ ተ ተ ተ ተ ተ ተ ተ ተ ተ ተ ተ	!	; ;	00.01	o	0	0
470 464.53 35 10.00 -2 -70 1 470 464.53 35 10.00 -2 -70 1 6.43 434.50 37 10.57 -3 -111 3 417 404.50 31 9.86 -4 -124 4 439 374.50 8 2.29 -5 -40 2		F10 T0	5.3.3	524.50		ž.	42101	7	-33	33
470 464-51 - 35 10.00 -2 -111 - 3 -111 - 3 - 111 - 3 - 111 - 3 - 111 - 3 - 111 - 3 - 111 - 3 - 124 - 4 - 124 - 4 - 124 - 4 - 109 - 374-50 - 6 - 2.29 - 5 - 40 - 2		4 60 10	000	494.57		 	9	• (
A 10.57 -3 -181 - 4 -124 - 4 -124 - 4 -124 - 4 -124 - 4 -124 - 4 -124 - 4 -124 - 4 - 10.9 - 374.50 - 6 - 2.29 - 5 - 40 - 2		4-0 10	470	464.53	:_	35	10.00	2	•	
417 404.50 11 8.86 -4 -124 109 374.50 8 2.29 -5 -60 2	ır.	. 420 TB	. 444	A 34 - 50		3.7	10.57	fC I	- 111	
109 374.50 8 2.29 -5 -40	,	150 TO	417			11	9.A6	4	#2T-	
	•		100			6	5.29	ın L	o i	

350 100.00

CUM F - X

349 99.71 347 99.14

344 98-29 338 96.57 298 85.14 228 65.14 181 (51.71

265 75.71

319 91-14

112 32.00 77 22.00

145 41.43

AESPRUPED FOR CHISO TESTS TO GIVE 13 INTERVALS WITHFREQUENCIES UF CHISO UNIFORM = 79.446 35 . 33 CHISO NATURE 0.81574

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HISTOGRAW FOR THE CONDITION WHEN REACH=2. S.I.=2.58 BITS. P.I.=2.58 BITS.

17 6			,	,	, , , , , ,	1 1 1 1	1		
10							1)	
21	670 TU	Han	0 3° V ii b	· m	200	:	;		•
	840 TJ	. 69£	664.59			:	£.	363	320 00000
	01 018			י	c n • 7	01	30	300	347 99.14
		1.50	624.50	m	0.86	o	27	243	344 98.20
n	780 TO	609	794.50	•	1.14	•0	-	4	
41	750 TD	6.2.2	764.50	æ	. 1221				
13	720 10	743	714.53	-		. ,	•	. 62	
12	650 10	719	70.00	. !	•	c	04	98 .71	331 94.57
	(F			2	4 + 85	ĸ	er er	¥25	321 91.71
	01.03		674.60	67 ·	7.14	•	100	004	
	630 TO	659	644.59	15	4.29	m	uh ∢	35.1	
·	600 10	629	614.57	24	6.86.	۸,	•		
6 0	570 TO	5,19	584.50	11	8.96		? =		
7 6 .	£40 TO	695	554,50	· -	11.71		• •	; ·	
- ·	£10 TO	139	424.60	• ፲	10.84	1)	5	
7. 10.	4F0 TO	199	403,50			<u>.</u>	. ' !	e m	166 49.00
*	450 10			ž.	14.86	۲,	-104	208	130 37.14
		7	461.50	£	10.86	r:	-114	342	78 22.29
7	420 TO	449	430.50	56	7.43	1	-104	416	
v.	1-30 TO	61v .	401.50	1.3	3.71	50	4		
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	360 TO	389	374.50	-	0.29	9) 40 }	5 25	00.4
REGHOUNED FC9 CHISO IE	TESTS. TO GI	VE IS INTERVALS	T) GIVE IS INTERVALS WITHFORDURACIES OF	1 1 1 1 <u>9</u>	1 1 1 1	SUMS	102	4268	
14 25 36		38 41 31	24 15		31				
CHISO NORMAL # 0.83154		SQ UNIFORM	123.23	· •			a	· .	

■ Galfel seet in later the Carl

FERDITY OF STREET OF TOWN FOR THE CONDITION WHEN REACHEZ. S.I.=2.59 HITS.

MAXIMUM = (883 MINIMUM = 381 PANGES 502 INTERVAL WIDTH:

WEAN = 5/4.02 IN INTERVAL 7. ST., DVN. = 103.46 MEDIAN = 546.50

190 FREG

HISTOGRAM FOR THE CONDITION WHEN REACH=1, S.I.=2.58 RITS, R.I.=2.00 BITS.

HAXIMUM = 644	MINIMUM = IN INTERVAL 7.	HININUM = 135 9ANGF = 509 ANTERVAL WIOTE	~	on t		¹ ~,
INT. NO.	EXACT LIMITS	TAIDE-DIM	1	, FD	Febes2	CUM F
1 1 1 1 1 1 1 1	1 2 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	1 0.29		121	350 100-00
e !	F40 10 53		00.0	10 , 01	0 1	
	780 TO HO3	774.50	5.0 5.7	5 F	988	347 99-14
	750 TO 779	764.5" PA	41.1		147	343 98.0
1 4	720 TO 743	734.50	LP G	, F.	216	340 97.1
	617 07.059	9 . 704,50	6 1.71	, K	375	334 95.4
	FEG TO 689	674.50	15 4-29		288	319 91.1
: :	£30 TO , 659	9 . 644.50		, F	225	301 86.0
: -	600 TO 629	9-11-6	41.4	201	*02	276 78.8
> 0	670 TD 599	6444.50	51 14.57	· ·		225 64.2
· 6	£40 TO 569	9 551453	11.011.		•	184 52.5
- F	53.9	9 524.50		` ## 	3.A	139 39.7
	460 TO 509			- 6-	188	101 28.8
	450 10 479	9 464.53		461	252	54 15.
• •,•	420 TD 449		28 8.00		. 352	5.6
	390 TO 019	٠,	22	- 15	75	•
	360 TO 36	389 374.50	n ·		36	-:
4	36 TO TO	359 344,50	1			

PEGERNIPEE FRY CHISO TESTS TO GIVE 12 INTERVALS WITHFREDUITNELES OF 1 24 24 51 25 19 10 CHISO UNFORM = 96.251

HISTOGRAM FOR THE CONDITION WHEN REACH=2. S.I.=2.58 91TS, R.I.=2.00 BITS. 454.50 524.50

				# 1 E	1 1 1	350, 100.00	99.71	99.43	€**66	99.43	94.43	99.43	99.43	49.43	99.43	99.43	98.86	98.86	96.29	90.86	15.71	57.71	31.14	6.00	
				<u> </u>	1	050	349	34.8	E .	3.4 A	348	348	34.8	348	E # E	348	346	346	337	. 318	265	202	601	21	
			,	F*)**2	1 1 1 1	225	196	, o	0	0	۰,	0	0	0	c	20	٥	4	. 76	m ic	•	66	382	189	
	0		,	9	` , 	<u>.</u>	-	0	0	•	0	0	0	0	c	0	o	21	, 89.E	E 6	0	, 6 -	-176	163	
	. 70			c	t 1 1	6-1	<u> </u>	13	12	=	01	•	6 0	~	ç	۲r	•	m	8		•	7	-2		
1.1.=2.00 HITS.	INTERVAL WIDTH =	MEDIAN # 539.50		ĸ,	; ; ; ; ;	0.29	0.29	00.0	00.0	00.0	00.0	00.0	00.0	00.0	00 0	0.57	0.00	2.57	5.43	15.14	18.00	26.457	\$1.32	00 00	
B BITS. R	128,	DEN.		u.	, ! !	-		0	0	0	0 :	0	0	0	0	~	o	٥	.61	53	r.c	£¢,	99	21	1
FREDUCYCY DISTRIBUTION FORTHE CONDITICY WHEN JEACH-2. S.I.=2.58 BITS. R.I.=2.00 HITS	391 GANGE=	ST. DVN. = 130.85		MIN-PCINT.	1 1 1 1 1 1 1	1644.5	1574.5	1 504.5	1434.5	. 5°671	1274,5	1234.5	1154.5	F 0 a b . F	1014.5	944.60	P 74 . 59	901.50	734.59	, 664.50	504,50	524.53	* CA. 4. F.O.	384.50	
ADITIC'S	*			175		1673	1603	1 533	1469	661 1	1329	1259	1189	1119	1049	976	606	930	169	669 .	629	559	487	. 419	
JT JON FORTHE CO	1670 MINIMUM	IN INTFRVAL		EXACT LIMITS	! ! ! ! ! ! !	1510 TO	1540 TD	1470 TO	1400 10	1,230 TO	1260 TO	1150 TO	1120 TO	CT 0201	. ut 085	910 TO	840 TO 1	770 TO	7 00 19	630 TO .	550 TO	450 TD	420 13	350 TO	i i i
FREGUENCY DISTRING	i i i i i i i i i i i i i i i i i i i	MEAN = 560.48		INT:	1 1 1 1 1 1 1	. :1	10	1.7	16	1.5	4 -	1.3	1.2	Ξ.	10		۳.		ç		•	*	۲:		1 1 1 1 1

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-175

SPECIAL POS CHISO TESTS TO GIVE 7 INTERVALS WITHFREQUENCIES OF CHISQ UNIFORM = 132.84 53 - 19 13 63 21 88 53. CHISC NJEMAL # 1.5522

274.50 324.50

HISTOGRAM FOR THE CONDITION WHEN REACH=1. 5.1.=2.58 BITS, P.I.=1.00 BIT.

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MAX 14UN II	889	HINIMOR	11	278 FANGE=	611	INTERVAL WIDTH	n	50	•	ı	
MEAN & SCO.CA		IN INTERVAL	. 0	ST. DVM. = 101.18		HEDIAN = 508.00		•		`	
.						ı		1	7.77		
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APPENDIX G

ANOVA SUMS OF SQUARES OUTPUTS

- 1. For Pilot-Study (Performance Time).
- · 2. For Major-Study (Performance Time).
 - 3. For Major-Study (Pulse Rate Difference).

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APPENDIX H

COMPUTER PROGRAMS

- 1. For Regression Analysis.
- 2. For Histograms.

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