TITLE: Tests for a Significant Difference Between Means

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ABSTRACT:

This program tests for the significance of a difference between means from large or small sample data. The means to be compared may be correlated or uncorrelated. In the case of uncorrelated means an F ratio is also computed.

DISCLAIMER:

DESCRIPTION

In order to test the significance of a difference between means for large or small, correlated or uncorrelated samples the program makes use of one of three statistical procedures.

    I.   In the uncorrelated small sample case, i. e. , the N of either sample is less than or equal to thirty, the program proceeds by computing a "t" ratio. Where,

$$t = \frac{(M_x - M_y) - (\mu_x - \mu_y)}{\dfrac{N_x S_x^2 + N_y S_y^2}{N_x + N_y - 2} \quad \dfrac{N_x + N_y}{N_x N_y}}$$

By using a t ratio, two assumptions are made. The first is that the two populations are each normally distributed, and the second is that the two populations have the same value for variance. Empirical tests show that normality of the two population needs only be roughly true, whereas homogeneity of the population variances is important and especially when small samples are used. Consequently we must first test the hypothesis that the two population standard deviations are equal. If this hypothesis of equality is rejected the t ratio is not an appropriate procedure under the particular circumstances. Whereas if the hypothesis can be accepted we may proceed with the t ratio assuming that the assumption has been met.

The statistical procedure used for testing the homogeneity of the two population variances is the two tailed F ratio. Where,

$$f = \frac{\dfrac{N_x S_x^2}{N_x - 1}}{\dfrac{N_y S_y^2}{N_y - 1}}$$

    II. In the uncorrelated large sample case the program proceeds by computing a Z or critical ratio. Where,

$$Z = \frac{(M_x - M_y) - (\mu_x - \mu_y)}{\sqrt{\dfrac{S_x^2}{N_x - 1} + \dfrac{S_y^2}{N_y - 1}}}$$

Since a critical ratio deals only with large sample data our estimates of population parameters should, according to the Central Limit Theorem, be generally good ones. Consequently, the limitations placed on the computation of a t ratio are ignored when computing a critical ratio.

III.   In the correlated large or small sample case the program proceeds by computing the differences of the paired variables and uses these differences in finding the critical ratio. The formula used is the same for small or large sample.

$$\left.\begin{array}{c} t_{corr.} \\ \\ z_{corr.} \end{array}\right\} = \frac{\overline{D}}{S_{\overline{D}}}$$

D = the difference between variable x_i and variable y_i

$$S_{\overline{D}} = \frac{\sqrt{\dfrac{\Sigma(D - \overline{D})^2}{N - 1}}}{\sqrt{N}}$$

N = the number of paired variables

The object in comparing two means is to reveal as clearly as possible the effect (if any) on these means of some treatment or condition while holding everything else constant. Obviously if the two means are dependent on each other a comparison between them will reflect this relationship.

In order to make the two sets of variables random with respect to each other we must either subtract the correlation from our estimated standard error of the difference, or actually work with the differences between the paired variables. To avoid computing a correlation coefficient this program makes use of the second procedure.

Limitations

1.   The data must be from 1-3 digit positive or negative whole numbers.

2.   The size of each sample must be less than or equal to 1000.

3.   The difference between the sample means must be less than or equal to 1023.

4.   When computing an uncorrelated t ratio the standard deviation of each sample must be less than or equal to 127.

5.   The population means (μ_1, μ_2) are assumed to be equal and the population variances are assumed to be unknown.

<u>Accuracy</u>   (See sample problem number 6).

The means are exact and everything else is accurate to two decimal places with the third decimal in error by ±.002.

<u>Time</u>   (Using high speed reader and punch).

$$t \quad = \quad (N - 1) + 30 \text{ sec.}$$

$$Z \qquad \frac{3N}{4} + 30 \text{ sec.}$$

$$\left.\begin{array}{l} t \text{ corr.} \\ Z \text{ corr.} \end{array}\right\} \qquad \frac{N - 1}{2} + 15 \text{ sec.}$$

<u>References</u>

Dixon, Massey
<u>Introduction to Statistical Analysis</u>
McGraw-Hill, 1957, pp. 115-129

McNemar
<u>Psychological Statistics</u>
Wiley, 1949, pp. 225-226

<u>OPERATING PROCEDURE</u>

The entire program requires 23 tracks of storage.

1.   Load program in Lo with Program Input Routine.
2.   Load 11.2 in Lo + 1400; 12.4 in Lo + 1700; 15.1 in Lo + 2100; 19.0 in Lo + 2200.
3.   Stop and transfer to Lo + 0402.
4.   Depress break point 16.
5.   Place data tape in reader and turn reader on.
6.   If the two samples are correlated depress transfer control.
7.   If output is by means of the high speed punch depress break

points 32 and 8, and turn the high speed punch on.

8.   Hit the start compute button on console.

NOTE:

If a series of data runs are on the same tape they may
be computed sequentially by depressing break point 4.
However, if this procedure is used the operator must
remember that the transfer control button is <u>down</u> for
correlated samples and <u>up</u> for uncorrelated samples.

SAMPLE PROBLEM

The sample problems are based on fictitious data set up to exemplify the
various sections of the program. The program was loaded in track 3.

DATA INPUT FORMAT

The data must be 1-3 digit positive or negative whole numbers. Negative
numbers must have the minus sign followed by 3 digits. For example a
minus fourteen would be -014' whereas a plus fourteen would just be 14'.

1.   For uncorrelated data

$$+27(L_o + 0453)' \text{ Project No.}' -0000000'^{*}$$
$$+10(L_o + 0454)' N_x' N_y' -0000000'$$
$$p+08(L_o + 0459)' F_{level}' -0000000''^{**}$$
$$x_1' y_1'$$
$$x_2' y_2'$$
$$x_3' y_3'$$
$$\cdot$$
$$\cdot$$
$$\cdot$$
$$x_n' y_n'^{***}$$
$$80000000'$$

---

* The project number may be any number six digits or less.

** The "F_{level}" refers to an actual numerical value obtained from the F
tables, not to just the significance level. The number is when either
sample has less than 31 cases.

*** If the number of cases in each sample are unequal, replace the missing
variables with zeros.

2.　　　For correlated data

$$+27(Lo + 0453)' \text{ Project No.}' -0000000''$$

Number of paired variables'

$$x_1'y_1'$$
$$x_2'y_2'$$
$$x_3'y_3'$$

.

.

.

$$x_n'y_n'$$
$$80000000'$$

Title: Tests for a Significant Difference Between Means
Author: Richard A. Cabot, MHRI
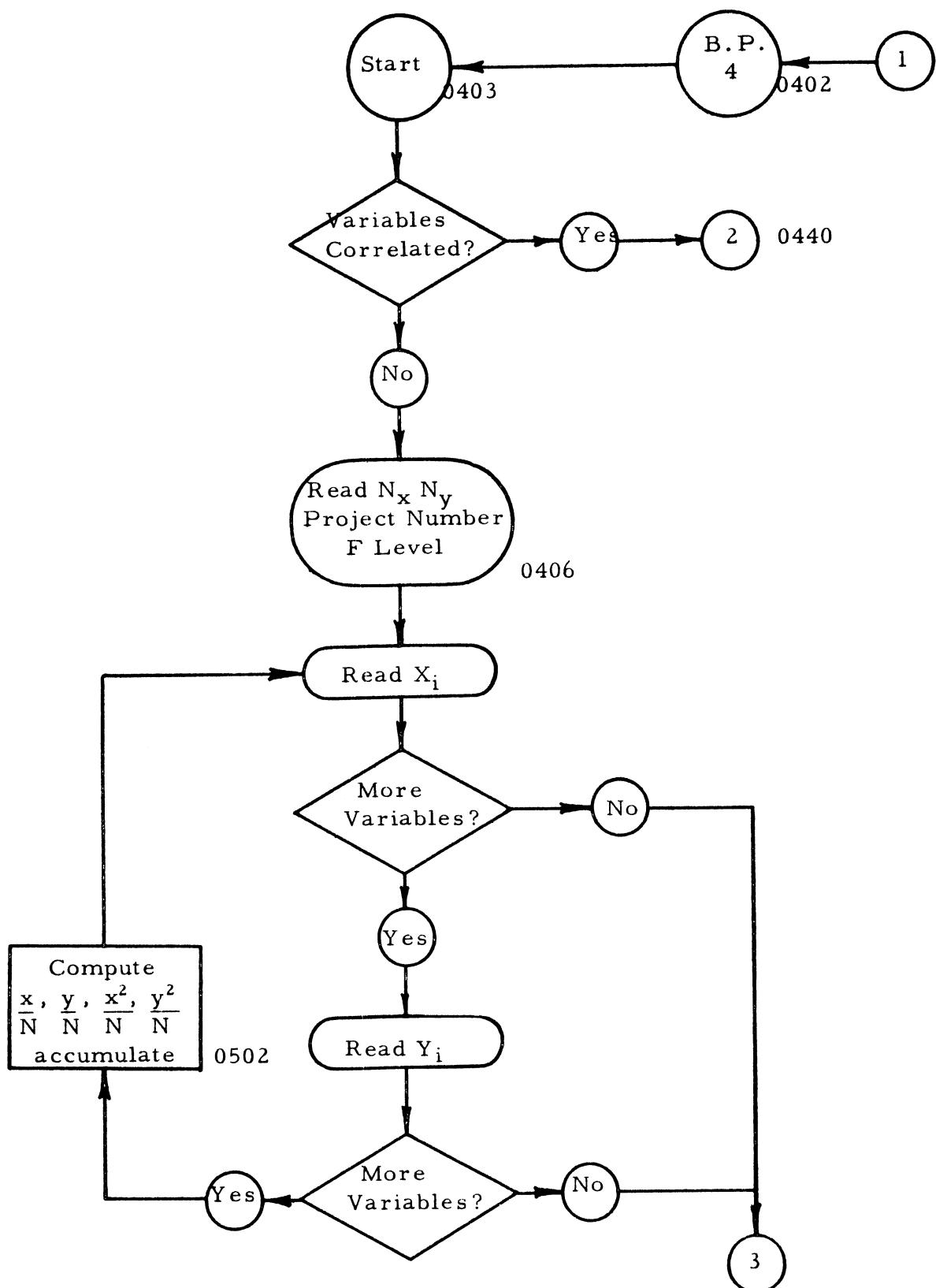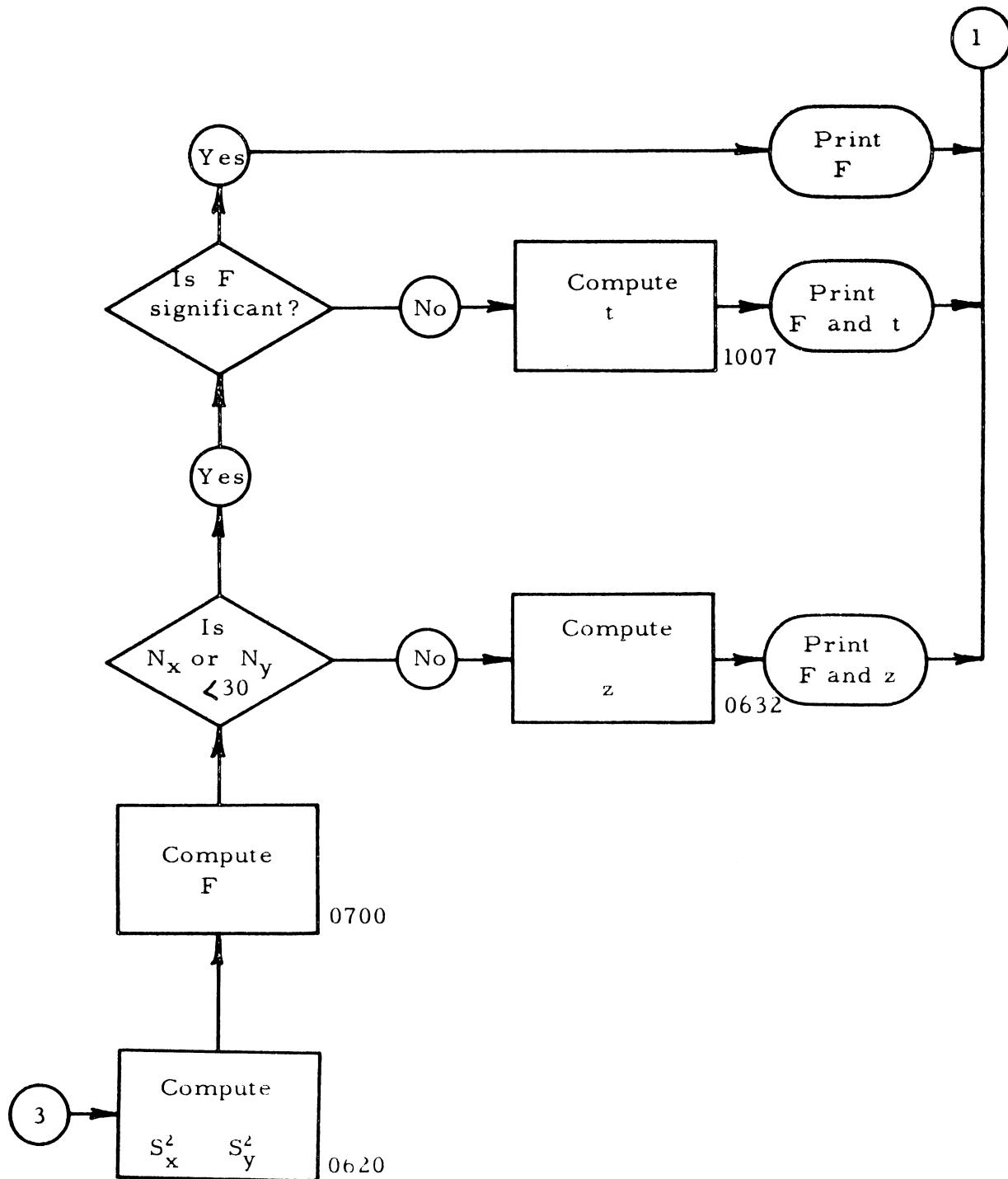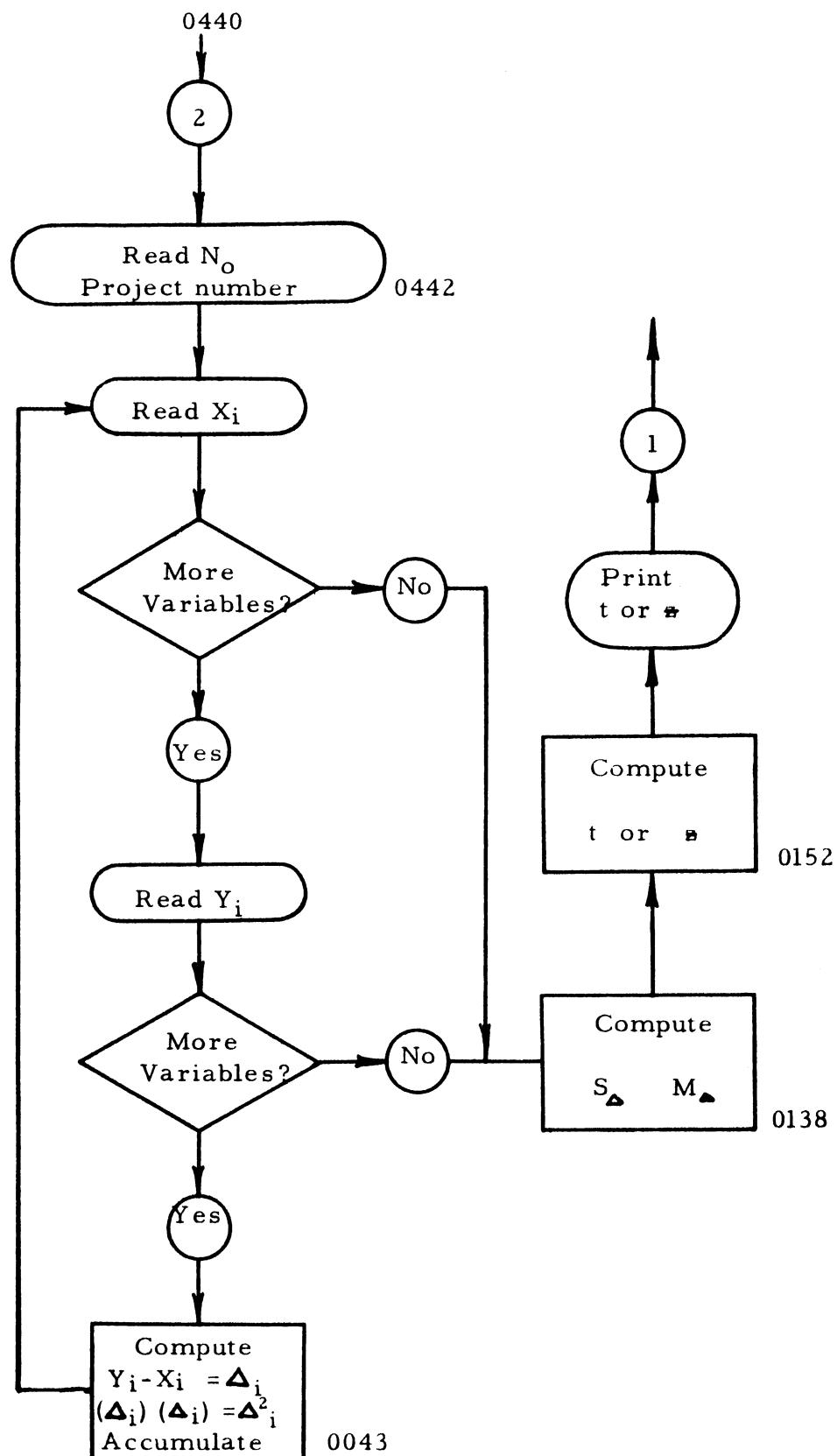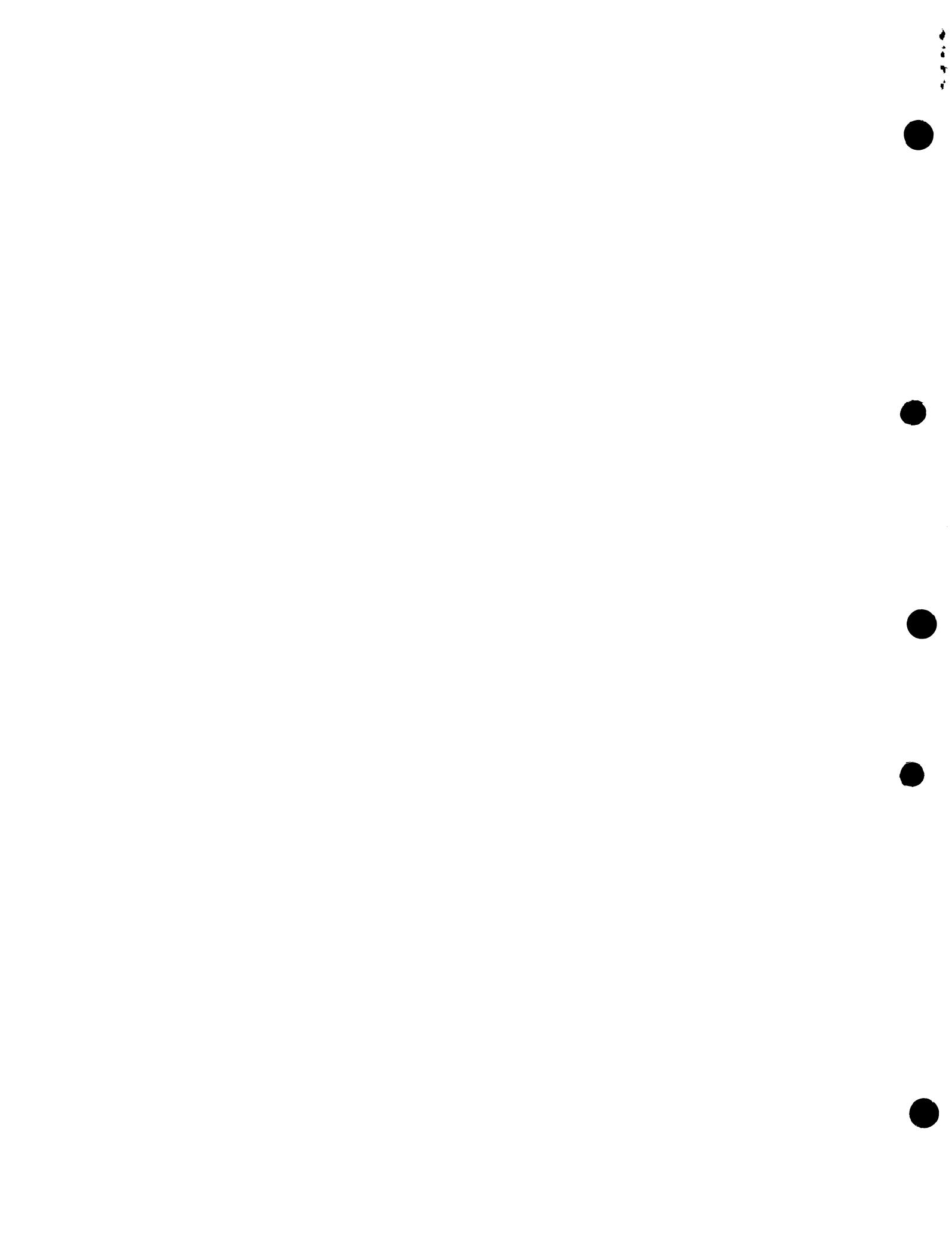
0440

(2)

Read N_o
Project number   0442

Read X_i

More
Variables?   No

Yes

Read Y_i

More
Variables?   No

Yes

Compute
$Y_i - X_i = \Delta_i$
$(\Delta_i)(\Delta_i) = \Delta^2_i$
Accumulate   0043

(1)

Print
t or ꬶ

Compute
t or ꬶ   0152

Compute
S_Δ M_Δ 0138

JOB NO. MHRI   PROG. NO. F6-217   PREP. BY RAC   CK'D. BY L.K.   DATE 12/20/60

PROBLEM **TESTS FOR A SIGNIFICANT DIFFERENCE BETWEEN MEANS**   TRACK 00

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OP.	ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	⊠						
, 0 0 0 0 0 1 1		0,0					
		0,1	2	0 0 0 0 0		1 @ 10	
		0,2					
		0,3			⊠		
		0,4	4	0 0 0 0 0 0		1 @ 5	
		0,5	(	)		$\sqrt{N}$ @ 5	
		0,6	4	0 0 0 0 0 0		1 @ 5	
		0,7			⊠		
		0,8					
		0,9	1 7 5 Q 7 4 2 F			$1/\sqrt{30}$ @ 0	
		1,0	(	)		Temp 1	
		1,1	x	C 6 3 6 1	⊠		
		1,2		C 0 2 3 6		$\Sigma \Delta^2$	
		1,3		C 0 2 2 4		$\Sigma \Delta$	
		1,4	x	P 0 0 0 0		Input N	
		1,5	x	I 0 0 0 0	⊠		
		1,6		R 0 2 0 4		N	
		1,7		U 0 1 0 2			
		1,8		D 0 0 0 4		1 @ 5	
		1,9		H 0 2 2 6	⊠	N @ 10	
		2,0		S 0 0 6 3		1 @ 10	
		2,1		H 0 2 3 5		N - 1 @ 10	
		2,2		A 0 0 0 1		1 @ 10	
		2,3		R 2 1 5 0	⊠	15.1	
		2,4		U 2 1 0 0			
		2,5	x	Z 1 6 1 1			
		2,6		C 0 0 0 5		$\sqrt{N}$ @ 5	
		2,7		B 0 0 0 6	⊠	1 @ 5	
		2,8		D 0 0 0 5		$\sqrt{N}$ @ 5	
		2,9		H 0 2 3 2		$1/\sqrt{N}$ @ 0	
		3,0		S 0 0 0 9		$1/\sqrt{30}$ @ 0	
		3,1		T 0 0 6 0	⊠	$\rightarrow N > 30$	

CONDITIONAL STOP CODE   ⊠ CARRIAGE RETURN

JOB NO. MHRI   PROG. NO. F6-217   PREP BY RAC   CK'D BY L.K.   DATE 12/20/60

PROBLEM FZt   TRACK 00

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OP.	ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	'						
	'	⊠					
		3 2	B 0 1 1 8		'	U 0210	
		3 3	C 0 3 4 5		'		
		3 4	x P 0 0 2 0		'	Input x_i	
		3 5	N I 0 0 0 0		' ⊠		
		3 6	R 0 2 0 4		'		
		3 7	U 0 1 0 2		'		
		3 8	C 0 0 1 0		'	Temp 1 @ 15	
		3 9	x P 0 0 2 5		' ⊠	Input y_i	
		4 0	x I 0 0 0 0		'		
		4 1	R 0 2 0 4		'		
		4 2	U 0 1 0 2		'		
		4 3	S 0 0 1 0		' ⊠	Temp 1 @ 15	
		4 4	H 0 2 2 3		'	Temp 2	
		4 5	A 0 2 2 4		'	$\Sigma \Delta$ @ 15	
		4 6	C 0 2 2 4		'		
		4 7	B 0 2 2 3		' ⊠	Temp 2	
		4 8	M 0 2 2 3		'	Temp 2	
		4 9	D 0 2 2 8		'	1 @ 10	C 20
		5 0	A 0 2 3 6		'	$\Sigma \Delta^2$ @ 20	
		5 1	C 0 2 3 6		' ⊠		
		5 2	U 0 0 3 4		'		
, 0 0 0 0 0 0 7	'	5 3			'		
		5 4			'		
		5 5			' ⊠		
		5 6			'		
		5 7			'		
		5 8			'		
		5 9			' ⊠		
		6 0	B 0 2 4 6		'	x U 0110	
		6 1	U 0 0 3 3		'		
, 0 0 0 0 0 0 2	'	6 2			'		
		6 3	2 0 0 0 0 0		' ⊠	1 @ 10	

CONDITIONAL STOP CODE   ⊠ CARRIAGE RETURN

DJ876 MUBLE TORONTO CANADA
FORM #802

JAN '7

JOB NO. MHRI PROG. NO. F6-217 PREP. BY RAC CK'D. BY L. K. DATE 12/20/60

PROBLEM FZt TRACK 01

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OP. ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	'					
	' ⊠					
.0000002	'	00		'		
		01		'		
		02	x T [ ]	'		end of data
		03	S 0253	' ⊠	1 @ 19	
		04	T 0126	'		→ pos. number
		05	N 0255	'	1 @ 30	
		06	R 0209	'		~~neg. number~~
		07	U 0114	' ⊠		
		08	x C 6358	'		
		09	U 0229	'		
		10	U 0346	'		
.0000003	'	11		' ⊠		
		12		'		
		13	1 w w Q	'		
		14	H 0243	'		
		15	E 0251	' ⊠		
		16	M 0252	'	-6 @ 4	
		17	U 0121	'		
		18	U 0210	'		
.0000002	'	19		' ⊠		
		20		'		
		21	A 0243	'	N_1	
		22	H 0258	'	N_2	
		23	E 0259	' ⊠		
		24	M 0260	'	-156 @ 8	
		25	U 0208	'		
		26	N 0255	'	1 @ 30	
		27	E 0113	' ⊠		
		28	R 0209	'		~~pos. number~~
		29	U 0114	'		
		30	N 0602	'	1 @ 16	@ 15
		31	U 0203	' ⊠		

CONDITIONAL STOP CODE   ⊠ CARRIAGE RETURN

D452280 McBEE TORONTO CANADA
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JAN. 57

JOB NO. __MHRI__ PROG. NO. __F6-217__ PREP. BY __RAC__ CK'D. BY __L.K.__ DATE __12/20/60__

PROBLEM _____ FZt _____ TRACK _____01_____

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OP.	ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	'						
	'	⊠					
, 0 0 0 0 0 0 1	'	3,2	1	0,0,0,0	'	1 @ 15	
		3,3	x P	2,4,4,2	'		
, 0 0 0 0 0 0 4	'	3,4	(	)	'	M_Δ @ 20	
		3,5		4,0,0	' ⊠	1 @ 21	
		3,6	(	)	'	M_Δ @ 10	for print
		3,7			'		
		3,8	B	0,2,2,4	'	Σ_Δ @ 15	
		3,9	M	0,2,2,4	' ⊠		$(\Sigma\Delta)^2$ @ 30
		4,0	D	0,2,2,6	'	N @ 10	@ 20
		4,1	S	0,2,3,6	'	Σ_Δ^2 @ 20	
		4,2	M	0,2,2,1	'	1 @ 0	
		4,3	M	0,5,2,9	' ⊠	1/Nd @ 0	@ 20
		4,4	R	2,1,5,0	'	15. 1	
		4,5	U	2,1,0,0	'		
		4,6	M	0,2,3,2	'	$1/\sqrt{N}$ @ 0	@ 10
		4,7	C	0,2,3,3	' ⊠	Sd @ 10	
		4,8	U	0,1,5,2	'		
, 0 0 0 0 0 0 3	'	4,9			'		
		5,0			'		
		5,1	2	0,0,0,0	' ⊠	1 @ 10	
		5,2	B	0,2,2,4	'	Σ_Δ @ 15	
		5,3	M	0,1,3,2	'	1 @ 15	@ 30
		5,4	D	0,2,2,6	'	N @ 10	@ 20
		5,5	H	0,1,3,4	' ⊠	M_Δ @ 20	
		5,6	D	0,2,3,3	'	Sd @ 10	
		5,7	C	0,2,4,3	'	Z or t @ 10	
		5,8	U	0,1,6,1	'		
, 0 0 0 0 0 0 2	'	5,9			' ⊠		
		6,0			'		
		6,1	B	0,2,2,6	'	N @ 10	
		6,2	M	0,2,4,8	'	1 @ 17	
		6,3	C	0,2,4,9	' ⊠	N @ 27	for print

CONDITIONAL STOP CODE   ⊠ CARRIAGE RETURN

D7387b McBEE TORONTO, CANADA
FORM #802

JAN. 57

JOB NO. MHRI   PROG. NO. F6-217   PREP. BY RAC   CK'D. BY L. K.   DATE 12/20/60

PROBLEM FZt   TRACK 02

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OP. ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	'					
	'	⊠				
		0,0	U 0 4 4 8	'		
, 0 0 0 0 0 0 2		0,1		'		
		0,2		'		
		0,3	x Z 1 6 5 3	' ⊠		
		0,4	x U [ ]	'		exit from Binarize
, 0 0 0 0 0 0 3	'	0,5		'		
		0,6		'		
		0,7		' ⊠		
		0,8	A 0 2 5 8	'	N_2	
		0,9	x U [ ]	'		exit from Bin. Rout.
		1,0	R 2 2 0 0		19.0	
		1,1	U 2 2 0 0	' ⊠		
, 0 0 0 0 0 0 2	'	1,2	1 8 5 F 1 8 1 0	'	C.S. t	C.S. U.C.
		1,3	1 6 0 8 V Q 0 0	'	= l.c.	EXIT
		1,4	R 1 7 0 3	'	12.4	
		1,5	U 1 7 0 0	' ⊠		
		1,6	Z 0 2 4 3	'	t	
		1,7	x Z 0 1 1 0	'		
		1,8	U 0 3 5 4	'		
, 0 0 0 0 0 1 0	'	1,9		' ⊠		
		2,0		'		
		2,1	8 0 0 0 0 0 0 0	'	1 @ 0	
		2,2	2 0 0 0 0 0	'	1 @ 10	
		2,3	( )	' ⊠	Temp 2	
		2,4	( )	'	$\Sigma\Delta$@ 15	
		2,5	8 0 0 0 0	'	1 @ 12	
		2,6	( )	'	N @ 10	
		2,7		⊠		
		2,8	2 0 0 0 0 0	'	1 @ 10	
		2,9	x S 6 3 5 8	'		complement
		3,0	N 0 6 0 2		1 @ 16	N @ 15
		3,1	U 0 2 0 3	' ⊠		

CONDITIONAL STOP CODE   ⊠ CARRIAGE RETURN

JOB NO. __MHRI__   PROG. NO. __F6-217__   PREP. BY __RAC__   CK'D. BY __L.K.__   DATE __12/20/60__

PROBLEM _____ FZt _____   TRACK __02__

PROGRAM INPUT CODES	STOP	LOCATION	OP.	ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	'						
	'	⊠					
,0,0,0,0,0,0,6	'	3,2	(	)	'	$1/\sqrt{N}$ @ 0	
		3,3	(	)	'	S_d @ 10	
		3,4			'		
		3,5	(	)	' ⊠	N-1 @ 10	
		3,6	(	)	'	$\Sigma\Delta^2$ @ 20	
		3,7			'		
		3,8	B	0,2,2,4	'	$\Sigma\Delta$ @ 15	
		3,9	M	0,2,2,5	' ⊠	1 @ 12	
		4,0	C	0,2,1,9	'	$\Sigma\Delta$ @ 27	for print
		4,1	U	0,3,0,6	'		
,0,0,0,0,0,0,4	'	4,2	(	)	'	Z or t @ 10	
		4,3	(	)	' ⊠	N_1	
		4,4	1,0,0,0,0,0		'	1 @ 7	
		4,5			'		
		4,6	U	0,1,1,0	'		
,0,0,0,0,0,1,5	'	4,7			' ⊠		
		4,8	4,0,0,0		'	1 @ 17	
		4,9	(	)	'	N @ 27	for print
		5,0			'		
		5,1	1 Q 1 Q 0		' ⊠		mask
		5,2	K 0,0,0,0,0,0		'	-6 @ 4	
		5,3	1,0,0,0		'	1 @ 19	
		5,4			'		
		5,5			' ⊠		
		5,6			'		
		5,7			'		
		5,8	(	)	'	N_2	
		5,9	1 w Q 0,0		' ⊠		
		6,0	G 2,0,0,0,0,0		'	-156 @ 8	
		6,1			'		
		6,2	B	0,4,3,4	'	1 @ 10	
		6,3	D	0,2,3,5	' ⊠	N-1 @ 10	

CONDITIONAL STOP CODE   ⊠ CARRIAGE RETURN

JOB NO. **MHRI**   PROG. NO. **F6-217**   PREP. BY **RAC**   CK'D. BY **L.K.**   DATE **12/20/60**

PROBLEM **FZt**   TRACK **03**

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OP. ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	'					
	'	⊠				
		0.0	C 0 5 2 9	'	1/N-1 @ 0	
		0.1	x Z 1 6 5 1	'		
		0.2	U 0 1 3 8	'		
, 0 0 0 0 0 0 3	'	0.3		'	⊠	
		0.4		'		
		0.5		'		
		0.6	B 0 4 3 5	'	xP 1642	
		0.7	C 2 0 2 7	'	⊠	12.4
		0.8	R 2 2 0 0	'	19.0	
		0.9	U 2 2 0 0	'		
, 0 0 0 0 0 0 6	'	1.0	2 0 2 0 1 0 4 2	'	C.R. C.R. U.C. P
		1.1	0 8 1 F 4 6 6 4	'	⊠	l.c. r o j
		1.2	4 F 6 F 5 F 0 6	'	e c t sp.
		1.3	1 0 3 2 0 8 5 2	'	U.C. N l.c. u
		1.4	3 F 0 F 4 F 1 F	'	m b e r
		1.5	V Q 0 0 0 0 0 0	'	⊠	EXIT
		1.6	R 1 7 0 3	'	12.4	
		1.7	U 1 7 0 0	'		
		1.8	Z 0 4 5 3	'	project number	
		1.9	x E 0 1 2 7	'	⊠	
		2.0	R 2 2 0 0	'	19.0	
		2.1	U 2 2 0 0	'		
, 0 0 0 0 0 0 2	'	2.2	1 0 3 2 2 4 1 6	'	u.c. N Δ =
		2.3	0 8 V Q 0 0 0 0	'	⊠	l.c. EXIT
		2.4	R 1 7 0 3	'	12.4	
		2.5	U 1 7 0 0	'		
		2.6	Z 0 2 4 9	'	N Δ	
		2.7	x Z 0 1 2 7	'	⊠	
		2.8	R 2 2 0 0	'	19.0	
		2.9	U 2 2 0 0	'		
, 0 0 0 0 0 0 2	'	3.0	1 0 3 F 2 4 1 6	'	U.C. M Δ =
		3.1	0 8 V Q 0 0 0 0	'	⊠	l.c. EXIT

CONDITIONAL STOP CODE   ⊠ CARRIAGE RETURN

D45228• MCBEE TORONTO CANADA
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JOB NO. __MHRI__ PROG. NO. __F6-217__ PREP. BY __RAC__ CK'D. BY __L.K.__ DATE __12/20/60__

PROBLEM __FZt__ TRACK __03__

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OP.	ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	'						
	'	⊠					
		3,2	R	1,7,0,3	'	12.4	
		3,3	U	1,7,0,0	'		
		3,4	Z	0,1,3,6	'	M Δ	
		3,5	x Z	0,1,1,0	' ⊠		
		3,6	R	2,2,0,0	'	19.0	
		3,7	U	2,2,0,0	'		
, 0,0,0,0,0,0,2	'	3,8	1,0,7,F	0,8,2,F	'	U. C.	S 1c. d
		3,9	1,0,1,6,0,8,V,Q		' ⊠	U. C.	= 1c. Exit
		4,0	R	1,7,0,3	'	12.4	
		4,1	U	1,7,0,0	'		
		4,2	Z	0,2,3,3	'	S$_d$	
		4,3	x Z	0,1,1,0	' ⊠		
		4,4	x C	6,3,3,0	'		
		4,5	x U [ ]		'		
		4,6	R	2,2,0,0	'	19.0	
		4,7	U	2,2,0,0	' ⊠		
, 0,0,0,0,0,0,2	'	4,8	1,0,1,8	0,2,1,8	'	U. C.	CS Z C.S.
		4,9	1,6,0,8,V,Q,0,0		'	=	l. c. Exit
		5,0	R	1,7,0,3	'	12.4	
		5,1	U	1,7,0,0	' ⊠		
		5,2	Z	0,2,4,3	'		
		5,3	x Z	0,1,1,0	'		
		5,4	B	0,1,3,3	'	xP 2442	
		5,5	C	2,0,2,7	' ⊠		12.4
E,X,I,T		5,6	U	0,0,0,2	'		
, 0,0,0,0,0,0,7	'	5,7			'		
		5,8					
		5,9			' ⊠		
		6,0			'		
		6,1			'		
		6,2			'		
		6,3			' ⊠		

CONDITIONAL STOP CODE   ⊠ CARRIAGE RETURN

D73876 MCBEE TORONTO, CANADA
FORM #802

JAN. 57

JOB NO. __MHRI__ PROG. NO. __F6-217__ PREP. BY __RAC__ CK'D. BY __L.K.__ DATE __12/20/60__

PROBLEM _____FZt_____ TRACK ____04____

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OP.	INSTRUCTION ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	'						
	'	⊠					
, 0 0 0 0 0 0 2	'	0 0			'		
		0 1			'		
E N T E R		0 2	x Z	0 4 5 2	'		
		0 3	B	0 4 4 6	' ⊠		
		0 4	8 0 0 T	0 4 4 0	'		→Variables correlated
		0 5	C	0 1 0 2	'		
		0 6	R	1 4 0 8	'	11.2	
		0 7	U	1 4 0 0	' ⊠		
		0 8	x C	6 3 5 8	'	F level complement @ 8	
		0 9	S	0 4 5 9	'		
		1 0	H	0 5 3 3	'		
		1 1	C	0 7 6 1	' ⊠		
		1 2	C	0 5 2 0	'		
		1 3	C	0 9 5 6	'		
		1 4	C	0 9 0 0	'		
		1 5	C	0 9 6 1	' ⊠		
		1 6	C	0 9 5 9	'		
		1 7	C	0 9 5 0	'		
		1 8	x P	0 0 0 4	'	Input X_i	
		1 9	x I	0 0 0 0	' ⊠		
		2 0	R	0 2 0 4	'	Binarize X_i	
		2 1	U	0 1 0 2	'		
		2 2	C	0 4 5 8	'		
		2 3	x P	0 0 0 9	' ⊠	Input Y_i	
		2 4	x I	0 0 0 0	'		
		2 5	U	0 4 2 9	'		
		2 6	T	0 2 6 2	'		
, 0 0 0 0 0 0 2	'	2 7			' ⊠		
		2 8			'		
		2 9	R	0 2 0 4	'	Binarize Y_i	
		3 0	U	0 1 0 2	'		
		3 1	x Z	1 6 1 7	' ⊠		

CONDITIONAL STOP CODE   ⊠ CARRIAGE RETURN

D452286 McBEE TORONTO, CANADA
FORM 1801

JOB NO. __MHRI__ PROG. NO. __F6-217__ PREP. BY __RAC__ CK'D. BY __L.K.__ DATE __12/20/60__

PROBLEM _____ FZt _____ TRACK __04__

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OP.	ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	'						
	'	⊠					
		3,2	C	0,9,5,4	'		
		3,3	U	0,5,0,2	'		
,0,0,0,0,0,0,1	'	3,4	2	0,0,0,0,0	'	1 @ 10	
		3,5	x P	1,6,4,2	'	⊠	
,0,0,0,0,0,0,4	'	3,6			'		
		3,7			'		
		3,8					
		3,9			'	⊠	
		4,0	B	0,4,2,6	'	T 0262	
		4,1	C	0,1,0,2	'		
		4,2	R	1,4,0,8	'	~~11.2~~	
		4,3	U	1,4,0,0	'	⊠	
		4,4	U	0,0,1,1	'		
,0,0,0,0,0,0,1	'	4,5			'		
		4,6	T	1,0,5,7	'		
,0,0,0,0,0,0,1	'	4,7			'	⊠	
		4,8	B	0,1,3,4	'	MΔ @ 20	
		4,9	N	0,1,3,5	'	1 @ 21	
		5,0	C	0,1,3,6	'	MΔ @ 10	for print
		5,1	U	0,3,0,6	'	⊠	
,0,0,0,0,0,1,2	'	5,2			'		
		5,3	(	)	'	Project Number	
		5,4	(	)	'	N_x	
		5,5	(	)	'	⊠ N_x	
		5,6			'		
		5,7					
		5,8	(	)	'	x_i	
		5,9	(	)	'	⊠ F level @ 8	
		6,0			'		
		6,1					
		6,2			'		
		6,3			'	⊠	

CONDITIONAL STOP CODE ⊠ CARRIAGE RETURN

D73876 McBEE TORONTO, CANADA
FORM 1802

JAN. 57

JOB NO. __MHRI__ PROG. NO. __F6-217__ PREP. BY __RAC__ CK'D. BY __L.K.__ DATE __12/20/60__

PROBLEM __FZt__ TRACK __05__

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OP. / ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	'					
	' ⊠					
, 0 0 0 0 0 0 2	'	0,0		'		
		0,1		'		
		0,2	B 0,4,5,8	'	X_i @ 15	
		0,3	M 0,4,5,8	' ⊠		
		0,4	D 0,4,5,4	'	N_x @ 10	
		0,5	x Z 1,6,5,5	'		
		0,6	A 0,9,5,6	'	$\frac{\Sigma x_i^2}{N_x}$ @ 20	
		0,7	C 0,9,5,6	' ⊠		
		0,8	B 0,4,5,8	'	X_i @ 15	
		0,9	M 0,7,5,9	'	1 @ 5	
		1,0	D 0,4,5,4	'	N_x @ 10	
		1,1	A 0,9,6,1	' ⊠	$\frac{\Sigma x}{N_x}$ @ 10	
		1,2	C 0,9,6,1	'		
		1,3	U 0,6,0,4	'		
		1,4	R 2,2,0,0	'	19.0	
		1,5	U 2,2,0,0	' ⊠		
, 0 0 0 0 0 0 2	'	1,6	2,0,1,8,5,F,1,8	'	C.R. C.S. t C.S.	
		1,7	1,0,1,6,0,8,V,Q	'	U.C. = l.c. EXIT	
		1,8	U 1,1,2,2	'		
, 0 0 0 0 0 1 9	'	1,9	2,0,0,0,0,0	' ⊠	1 @ 10	
		2,0	( )	'	F @ 8	$x > y$
		2,1	8,0	'	1 @ 24	
		2,2	2,0,0,0,0,0	'	1 @ 10	
		2,3		' ⊠		
		2,4		'		
		2,5	3,J,0,0,0,0	'	30 @ 10	
		2,6		'		
		2,7		' ⊠		
		2,8	4	'	1 @ 29	
		2,9	( )	'	1/N-1 @ 0	
		3,0		'		
		3,1		' ⊠		

CONDITIONAL STOP CODE   ⊠ CARRIAGE RETURN

JOB NO. __MHRI__ PROG. NO. __F6-127__ PREP. BY __RAC__ CK'D. BY __L.K.__ DATE __12/20/60__

PROBLEM _____FZt_____ TRACK __05__

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OP.	INSTRUCTION ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	'						
	'	⊠					
		3,2			'		
		3,3	(	)	'	F_{level} complement @ 8	
		3,4			'		
		3,5			'	⊠	
		3,6			'		
		3,7			'		
		3,8	Z	1,3,3,9	'		
,0,0,0,0,0,0,6	'	3,9			'	⊠	
		4,0	2,0	0,0,0,0	'	1 @ 10	
		4,1			'		
		4,2		8,0	'	1 @ 24	
		4,3			'	⊠	
		4,4					
		4,5	B,0	9,1,7	'	S_y^2 @ 20	
		4,6	M,0	9,3,2	'	$1/N_{y-1}$ @ 0	
		4,7	H,0	8,3,3	'	⊠ S_y^2/N_{yx} @ 20	
		4,8	A,0	9,3,4			
		4,9	R,2	1,5,0	'	15.1	
		5,0	U,2	1,0,0	'		
		5,1	U,0	6,5,7	'	⊠	
		5,2	B,0	5,3,8	'	Z 1339	
		5,3	Y,1	3,1,0	'		
		5,4	B,1	3,3,3	'	Z 1350	
		5,5	Y,1	3,4,9	'	⊠	
		5,6	U,1	2,0,0	'		
,0,0,0,0,0,0,7	'	5,7	2,0	0,0,0,0	'	1 @ 10	
		5,8			'		
		5,9			'	⊠	
		6,0			'		
		6,1	(	)		$\sqrt{\dfrac{N_y}{N_y-1}}$ @ 5	
		6,2	(	)	'	S_y	for print
		6,3		8,0	'	⊠ 1 @ 24	

CONDITIONAL STOP CODE   ⊠ CARRIAGE RETURN

JOB NO. MHRI   PROG. NO. F6-217   PREP. BY RAC   CK'D. BY L.K.   DATE 12/20/60

PROBLEM FZt   TRACK 06

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OP. ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	'					
	'	⊠				
,0000001	'	0.0		'		
		0.1	Z 0950	'		
		0.2	8000	'	1 @ 16	
		0.3		' ⊠		
		0.4	B 0954	'	y_i @ 15	
		0.5	M 0954	'		y_i^2 @ 30
		0.6	D 0455	'	N_y @ 10	
		0.7	x Z 1657	' ⊠	2 $\dfrac{\Sigma y_i}{N_y}$ @ 20	
		0.8	A 0959	'		
		0.9	C 0959	'		
		1.0	B 0954	'		
		1.1	M 0861	' ⊠	1 @ 5	
		1.2	D 0455	'		
		1.3	A 0900	'	$\dfrac{\Sigma y_i}{N_y}$ @ ~~10~~	
		1.4	C 0900	'		
		1.5	U 0418	' ⊠		
		1.6	B 1002	'	Z 0950	y > x
		1.7	Y 1308	'		
		1.8	U 0853	'		
,0000001	'	1.9		' ⊠		
		2.0	B 0961	'	$\dfrac{\Sigma x_i}{N_y}$ @ 10	
		2.1	M 0961	'		
		2.2	C 0908	'	$\left(\dfrac{\Sigma x_i}{N_y}\right)^2$ @ 20	
		2.3	B 0956	' ⊠	$\dfrac{\Sigma x_i^2}{N_x}$ @ 20	
		2.4	S 0908	'		
		2.5	C 0911	'	S_x^2 @ 20	
		2.6	B 0900	'	$\dfrac{\Sigma y_i}{N_y}$ @ 10	
		2.7	M 0900	' ⊠	$\left(\dfrac{\Sigma x_i}{N_y}\right)$ @ 10	
		2.8	C 0914	'		
		2.9	B 0959	'	$\dfrac{\Sigma y_i}{N_y}$ @ ~~20~~	
		3.0	S 0914	'		
		3.1	C 0917	' ⊠	S_y^2 @ 20	

CONDITIONAL STOP CODE   ⊠ CARRIAGE RETURN

JOB NO. MHRI   PROG. NO. F6-217   PREP BY RAC   CK'D. BY L.K.   DATE 12/20/60

PROBLEM FZt   TRACK 06

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OP	ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	'						
	' ⊠						
		3,2	B	0 4 5 4	'	N_x @ 10	
		3,3	S	0 5 1 9	'	1 @ 10	
		3,4	C	0 8 2 10	'	$N_x - 1$ @ 10	
		3,5	B	0 4 5 5	' ⊠	N_y @ 10	
		3,6	S	0 5 2 2	'	1 @ 10	
		3,7	C	0 9 2 3	'	$N_y - 1$ @ 10	
		3,8	XZ	1 6 2 4	'		
		3,9	B	0 4 5 4	' ⊠	N_x @ 10	
		4,0	XZ	1 6 2 6	'		
		4,1	S	0 5 2 0	'	30 @ 10	
		4,2	T	0 7 0 0	'		Compute F
		4,3	B	0 2 2 2	' ⊠	1 @ 10	
		4,4	D	0 9 2 3	'	$N_y - 1$ @ 10	
		4,5	XZ	1 6 3 1	'		
		4,6	C	0 9 3 2	'	$1/N_y - 1$ @ 0	
		4,7	B	0 8 2 6	' ⊠	1 @ 10	
		4,8	D	0 8 2 10	'	$N_y - 1$ @ 10	
		4,9	C	0 9 3 5	'	$1/N_x - 1$ @ 0	
		5,0	B	0 4 5 5	'	N_y @ 10	
		5,1	S	0 5 2 3	' ⊠	30 @ 10	
		5,2	T	0 7 0 0	'		Compute F
		5,3	B	0 9 1 1	'	S_x^2 @ 20	
		5,4	M	0 9 3 5	'	$1/N_x - 1$ @ 0	
		5,5	C	0 9 3 4	' ⊠	$S_x^2/N_x - 1$ @ 20	
		5,6	U	0 5 4 5	'		
		5,7	C	0 9 4 3	'	est. σ diff. @ 10	
		5,8	B	0 9 6 1	'	M_x @ 10	
		5,9	S	0 9 0 0	' ⊠	M_y @ 10	
		6,0	H	0 9 4 6	'	$M_x - M_y$ @ 10	
		6,1	M	0 5 4 0	'	1 @ 10	@ 20
		6,2	D	0 9 4 3	'	est. σ diff. @ 10	
		6,3	C	0 9 4 9	' ⊠	Z @ 10	

CONDITIONAL STOP CODE   ⊠ CARRIAGE RETURN

D73876 MCBEE TORONTO, CANADA
FORM #802

JOB NO. __MHRI__ PROG. NO. __F6-217__ PREP. BY __RAC__ CK'D. BY __L.K.__ DATE __12/20/60__

PROBLEM _____ FZt _____ TRACK __07__

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OP.	ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	'						
	'	⊠					
		0,0	B	0 4 5 4	'	N_x @ 10	
		0,1	M	0 1 5 1	'	1 @ 10	@ 20
		0,2	D	0 8 2 0	'	N_x-1 @ 10	
		0,3	R	2 1 5 0	' ⊠	15.1	
		0,4	U	2 1 0 0	'		
		0,5	C	0 9 5 5	'	$\sqrt{N_x/N_{x-1}}$ @ 5	
		0,6	B	0 4 5 5	'	N_y @ 10	
		0,7	M	0 5 5 7	' ⊠	1 @ 10	
		0,8	D	0 9 2 3	'	N_y-1 @ 10	
		0,9	R	2 1 5 0	'	15.1	
		1,0	U	2 1 0 0	'		
		1,1	C	0 5 6 1	' ⊠	$\sqrt{N_y/N_y-1}$ @ 5	
		1,2	B	0 9 1 1	'	S_x^2 @ 20	
		1,3	R	2 1 5 0	'	15.1	
		1,4	U	2 1 0 0	'		
		1,5	C	0 9 0 1	' ⊠	S_x @ 10	
		1,6	B	0 9 1 7	''	S_y^2 @ 20	
		1,7	R	2 1 5 0	'	15.1	
		1,8	U	2 1 0 0	'		
		1,9	H	0 5 6 2	' ⊠	S_y @ 10	
		2,0	M	0 5 6 1	'		
		2,1	C	0 9 0 7	'	F_y @ 15	
		2,2	B	0 9 0 1	'		
		2,3	M	0 9 5 5	' ⊠		
		2,4	H	0 9 6 0	'	F_x @ 15	
		2,5	S	0 9 0 7	'	F_y @ 15	
		2,6	T	0 7 6 2	'		
		2,7	B	0 9 0 7	' ⊠	F_y @ 15	
		2,8	N	0 5 2 1	'	1 @ 24	
		2,9	C	0 9 1 5	'	F_y @ 8	
		3,0	B	0 9 6 0	'	F_x @ 15	
		3,1	M	1 0 0 3	' ⊠	1 @ 1	

CONDITIONAL STOP CODE   ⊠ CARRIAGE RETURN

JOB NO. __MHRI__   PROG. NO. __F6-217__   PREP BY __RAC__   CK'D BY __L.K.__   DATE __12/20/60__

PROBLEM __FZt__   TRACK __07__

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OP. ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	'	⊠				
		3,2	D 0 9 1 5	'	F_y @ 8	@ 8
		3,3	U 0 7 5 5	'		
		3,4	C 0 5 2 0	'	F @ 8	x > y
		3,5	B 0 4 5 4	' ⊠	N_x @ 10	
		3,6	S 1 1 0 8	'	30 @ 10	
		3,7	T 0 8 0 9	'	N_x < 30	
		3,8	B 0 4 5 5	'	N_y @ 10	
		3,9	S 0 5 2 5	' ⊠	30 @ 10	
		4,0	T 0 8 0 9	'	N_y < 30	
		4,1	B 0 5 2 0	'	F @ 8	x > y
		4,2	S 0 5 2 8	'	1 @ 29	
		4,3	T 1 1 1 5	' ⊠	y > x	loc. 0950 contains F'
		4,4	B 0 8 3 0	'	Z 0520 xzy	loc. 0520 contains F'
		4,5	Y 1 3 0 8	'		
		4,6	U 1 3 1 1	'		
, 0 0 0 0 0 0 0 8	'	4,7	4 0 0 0	' ⊠	1 @ 17	
		4,8		'		
		4,9		'		
		5,0	( )	'	F_x @ 8	
		5,1		' ⊠		
		5,2	4 0 0 0 0 0 0 0	'	1 @ 1	
		5,3		'		
		5,4		'		
		5,5	H 0 9 4 1	' ⊠		@ 8
		5,6	M 0 9 4 1	'		
		5,7	M 0 8 2 2	'	1 @ 23	F @ 8
		5,8	U 0 7 3 4	'		
, 0 0 0 0 0 0 3	'	5,9	4 0 0 0 0 0 0 0	' ⊠	1 @ 5	
		6,0	2	'	1 @ 30	
		6,1	( )	'	F level complement @ 8	
		6,2	B 0 9 6 0	'	F_x @ 15	
		6,3	N 0 5 4 2	' ⊠	1 @ 24	

CONDITIONAL STOP CODE   ⊠ CARRIAGE RETURN

JOB NO. __MHRI__   PROG. NO. __F6-217__   PREP. BY __RAC__   CK'D. BY __L.K.__   DATE __12/20/60__

PROBLEM _____ FZt _____ TRACK ____08____

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OP.	ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	'						
	'	☒					
		0,0	C 0 7 5 0		'	F_x @ 8	
		0,1	B 0 9 0 7		'	F_y @ 15	
		0,2	M 0 7 5 2		'	1 @ 1	F_y @ 16
		0,3	D 0 7 5 0		' ☒	F_x @ 8	
		0,4	U 0 8 4 0		'		
		0,5	C 0 9 5 0		'	F @ 8	y > x
		0,6	U 0 7 3 5		'		
, 0 0 0 0 0 0 2	'	0,7			' ☒		
		0,8	8		'	1 @ 28	
		0,9	B 0 9 5 0		'	F @ 8	y > x
		1,0	S 0 7 6 0		'	1 @ 30	
		1,1	T 0 8 4 7		' ☒	x > y	loc. 0520 contains F
		1,2	B 0 7 6 1		'	- F level @ 8	loc. 0950 contains F
		1,3	A 0 9 5 0		'	F @ 8	y > x
		1,4	T 1 0 0 7		'		
		1,5	B 0 6 0 1		' ☒	Z 0950	y > x
		1,6	Y 1 3 0 8		'		
		1,7	U 0 5 5 2		'		
, 0 0 0 0 0 1 2	'	1,8			'		
		1,9	1 0 0		' ☒	1 @ 23	
		2,0	( )		'	N_{x-1} @ 10	
		2,1	1 0 0		'	1 @ 23	
		2,2	1 0 0		'	1 @ 23	
		2,3	2 0 0 0 0 0		' ☒	1 @ 10	
		2,4			'		
		2,5			'		
		2,6	2 0 0 0 0 0		'	1 @ 10	
		2,7	2 0		' ☒	1 @ 26	
		2,8	2		'	1 @ 30	
		2,9	2		'	1 @ 30	
		3,0	Z 0 5 2 0		'		
, 0 0 0 0 0 0 5	'	3,1			' ☒		

JOB NO. MHRI PROG. NO. F6-217 PREP. BY RAC CK'D. BY L.K. DATE 12/20/60

PROBLEM FZt TRACK 08

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OP.	ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	'						
	'	⊠					
		3,2	2,0	0,0,0,0,0	'	1 @ 6	
		3,3	(	)	'	$S_y^3/N_y - 1$ @ 20	
		3,4					
		3,5			'	⊠	
		3,6	Z,0	5,2,0	'		
,0,0,0,0,0,0,1	'	3,7			'		
		3,8	Z,0	5,2,0	'		
		3,9	Z,1	3,3,9	'	⊠	
		4,0	H,0	9,2,6	'		
		4,1	M,0	9,2,6	'		
		4,2	N,0	8,2,1	'	1 @ 23	F @ 8
		4,3	U,0	8,0,5	'	⊠	
,0,0,0,0,0,0,3	'	4,4	4,0	0,0	'	1 @ 18	
		4,5			'		
		4,6			'		
		4,7	B,0	5,3,3	'	⊠ F level complement @ 8	
		4,8	A,0	5,2,0	'	F @ 8	
		4,9	T,1	0,0,7	'		Compute t
		5,0	B,0	8,3,6	'	Z 0520	
		5,1	Y,1	3,0,8	'	⊠	
		5,2	U,1	3,2,4	'		
		5,3	B,0	8,3,9	'	Z 1339	
		5,4	Y,1	3,1,0	'		
		5,5	B,1	1,4,1	'	⊠ Z 0514	
		5,6	Y,1	3,4,9	'		
		5,7	U,1	2,0,0	'		
,0,0,0,0,0,0,6	'	5,8	2,0	0,0,0,0	'	1 @ 10	
		5,9	8		'	⊠ 1 @ 28	
		6,0	(	)	'	$(N_x + N_y) - 2$ @ 7	
		6,1	4,0	0,0,0,0	'	1 @ 5	
		6,2		4,0	'	1 @ 25	
		6,3			'	⊠	

CONDITIONAL STOP CODE   ⊠ CARRIAGE RETURN

JOB NO. __MHRI__ PROG. NO. __F6-217__ PREP. BY __RAC__ CK'D. BY __L. K.__ DATE __12/20/60__

PROBLEM __FZt__ TRACK __09__

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OP. ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	'					
	'	⊠				
, 0 0 0 0 0 6 4	'	0,0	( )	'	$\frac{\Sigma y}{N_y}$ @ 10	
		0,1	( )		S_x @ 10	
		0,2	( )		F_x @ 8	
		0,3	( )	'	⊠$N_x S_x^2$ @ 21	
		0,4				
		0,5		'		
		0,6	( )		S_y^2 @ 14	
		0,7	( )	'	⊠ F_y @ 15	
		0,8	( )	'	$(\frac{\Sigma x}{N})^2$ @ 20	
		0,9		'		
		1,0		'		
		1,1	( )	'	⊠ S_x^2 @ 20	
		1,2		'		
		1,3	( )	'	$N_x S_x^2 + N_y S_y^2 /$	$(N_x + N_y) - 2$ @ 14
		1,4	( )	'	$(\frac{\Sigma y^2}{N})$ @ 20	
		1,5	( )	'	⊠ F_y @ 8	
		1,6	( )	'	$\sqrt{}$ ← @ 7	
		1,7	( )	'	S_y^2 @ 20	
		1,8				
		1,9		'	⊠	
		2,0	( )	'	$N_x N_y$ @ 10	
		2,1				
		2,2		'		
		2,3	( )	'	⊠$N_y - 1$ @ 10	
		2,4		'		
		2,5				
		2,6	( )	'	Temp.	
		2,7	( )	'	⊠ t @ 10	
		2,8		'		
		2,9	( )	'	$\sqrt{}$ @ 6	
		3,0		'		
		3,1		'	⊠	

CONDITIONAL STOP CODE   ⊠ CARRIAGE RETURN

D45226° McBEE TORONTO, CANADA
FORM #801

JOB NO. __NHRI__   PROG. NO. __F6-217__   PREP BY __RAC__   CK'D. BY __L.K.__   DATE __12/20/60__

PROBLEM _____ FZt _____   TRACK __09__

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OP.	INSTRUCTION ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	'						
	'	⊠					
		3,2 (		)	'	$1/N_x-1$ @ 0	
		3,3			'		
		3,4 (		)	'	S_x^2/N_x-1 @ 20	
		3,5 (		)	'	⊠ $1/N_x-1$ @ 0	
		3,6			'		
		3,7			'		
		3,8			'		
		3,9			'	⊠	
		4,0			'		
		4,1 (		)	'	Temp	
		4,2			'		
		4,3 (		)	'	⊠ est. σ diff. @ 8	
		4,4			'		
		4,5 (		)	'	N_x @ 27	
		4,6 (		)	'	$M_x - M_y$ @ 10	
		4,7			'	⊠	
		4,8 (		)	'	N_y @ 27	
		4,9 (		)	'	Z @ 10	
		5,0 (		)	'	F @ 8	$y > x$
		5,1			'	⊠	
		5,2			'		
		5,3			'		
		5,4 (		)	'	y_i @ 15	
		5,5 (		)	'	⊠ $\sqrt{N_x/N_x-1}$ @ 5	
		5,6 (		)	'	$\frac{\Sigma x^2}{N_x}$ @ 20	
		5,7 (		)	'		
		5,8			'		
		5,9 (		)	'	⊠ $\frac{\Sigma y^2}{N_y}$ @ 20	
		6,0 (		)	'	F_x @ 15	
		6,1 (		)	'	$\frac{\Sigma x}{N_x}$ @ 10	
		6,2 (		)	'	N_x @ 6	
		6,3 (		)	'	⊠ S_x^2 @ 14	

CONDITIONAL STOP CODE   ⊠ CARRIAGE RETURN

D73876 MCBEE TORONTO, CANADA
FORM #802

JOB NO. **MHRI** PROG. NO. **F6-217** PREP. BY **RAC** CK'D. BY **L.K.** DATE **12/20/60**

PROBLEM **FZt** TRACK **10**

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OP. ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	'					
	'	⊠				
, 0 0 0 0 0 0 2	'	0,0		'		
		0,1	8	'	1 @ 28	
		0,2	Z 0,9,5,0	'		
, 0 0 0 0 0 0 4	'	0,3	4 0,0,0,0,0,0,0	' ⊠	1 @ 1	
		0,4	4,0,0,0,0,0,0	'	1 @ 5	
		0,5	4,0	'	1 @ 25	
		0,6		'		
		0,7	B 0,8,2,0	' ⊠	$N_x - 1$ @ 10	
		0,8	A 0,9,2,3	'	$N_y - 1$ @ 10	
		0,9	N 0,8,5,9	'	1 @ 28	
		1,0	C 0,8,6,0	'	$(N_x + N_y) - 2$ @ 7	
		1,1	B 0,9,1,1	' ⊠	S_x^2 @ 20	
		1,2	N 0,8,6,2	'	1 @ 25	
		1,3	C 0,9,6,3	'	S_x^2 @ 14	
		1,4	B 0,4,5,4	'	N_x @ 10	
		1,5	N 1,0,0,1	' ⊠	1 @ 28	N_x @ 7
		1,6	M 0,9,6,3	'	S_x^2 @ 14	
		1,7	C 0,9,0,3	'	$N_x S_x^2$ @ 21	
		1,8	B 0,9,1,7	'	S_y^2 @ 20	
		1,9	N 1,0,0,5	' ⊠	1 @ 25	
		2,0	C 0,9,0,6	'	S_y^2 @ 14	
		2,1	B 0,4,5,5	'	N_y @ 10	
		2,2	N 0,8,0,8	'	1 @ 28	
		2,3	M 0,9,0,6	' ⊠	S_y^2 @ 14	$N_y S_y^2$ @ 21
		2,4	A 0,9,0,3	'	$N_x S_x^2$ @ 21	
		2,5	x Z 1,6,1,1	'		
		2,6	D 0,8,6,0	'	$(N_x + N_y) - 2$ @ 7	
		2,7	H 0,9,1,3	' ⊠	$N_x S_x^2 + N_x S_y^2 /$ $(N_x + N_y) - 2$ @ 14	
		2,8	R 2,1,5,0	'	15.1	
		2,9	U 2,1,0,0	'		
		3,0	C 0,9,1,6	'	$\sqrt{\leftarrow}$ @ 7	
		3,1	B 0,4,5,4	' ⊠	N_x @ 10	

CONDITIONAL STOP CODE ⊠ CARRIAGE RETURN

JOB NO. **MHRI**   PROG. NO. **F6-217**   PREP. BY **RAC**   CK'D. BY **L.K.**   DATE **12/20/60**

PROBLEM **FZt**   TRACK **10**

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OP.	ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	'						
	'	⊠					
		3,2	M	0 4 5 5	'	N_y @ 10	
		3,3	N	0 8 1 9	'	1 @ 23	
		3,4	C	0 9 2 0	'	$N_x N_y$ @ 12	
		3,5	B	0 4 5 4	' ⊠	N_x @ 10	
		3,6	A	0 4 5 5	'		$N_x + N_y$ @ 10
		3,7	M	0 8 2 3	'	1 @ 10	@ 20
		3,8	D	0 9 2 0	'		
		3,9	R	2 1 5 0	' ⊠	——————	
		4,0	U	2 1 0 0	'	$\sqrt{}\rightarrow$	
		4,1	M	0 9 1 6	'	$\overline{\sqrt{}\leftarrow}$	
		4,2	N	1 1 1 4	'	1 @ 26	
		4,3	C	0 9 2 9	' ⊠	$\overline{\sqrt{}}$ @ 6	
		4,4	B	0 9 6 1	'	M_x @ 10	
		4,5	S	0 9 0 0	'	M_y @ 10	
		4,6	M	0 8 3 2	'	1 @ 6	
		4,7	D	0 9 2 9	' ⊠		
		4,8	C	0 9 2 7	'	t @ 10	
		4,9	B	0 5 2 0	'	F @ 7	x > y
		5,0	S	0 8 2 9	'	1 @ 30	
		5,1	T	0 6 1 6	' ⊠	y > x	loc. 0950 contains F
		5,2	B	0 8 3 8	'	Z 0520	loc. 0520 contains F
		5,3	Y	1 3 0 8	'		
		5,4	U	1 3 1 9	'		
, 0 0 0 0 0 0 2	'	5,5			' ⊠		
		5,6			'		
		5,7	B	0 4 5 4	'	N_x @ 10	
		5,8	M	0 8 4 4	'	1 @ 17	
		5,9	C	0 9 4 5	' ⊠	N_x @ 27	for print
		6,0	B	0 4 5 5	'	N_y @ 10	
		6,1	M	0 7 4 7	'	1 @ 17	
		6,2	C	0 9 4 8	'	N_y @ 27	for print
		6,3	U	0 6 3 0	' ⊠		

CONDITIONAL STOP CODE   ⊠ CARRIAGE RETURN

D73878 MCBEE TORONTO, CANADA
FORM #802

JOB NO. __MHRI__ PROG. NO. __F6-217__ PREP. BY __RAC__ CK'D. BY __L.K.__ DATE __12/20/60__

PROBLEM __FZt__ TRACK __11__

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OP. ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	'					
	'	⊠				
, 0 0 0 0 0 0 3	'	0,0		'		
		0,1		'		
		0,2		'		
		0,3	Z 1 3 3 9	' ⊠		
		0,4	Z 1 1 4 6	'		
		0,5	Z 1 1 2 8	'		
, 0 0 0 0 0 0 1	'	0,6		'		
		0,7	Z 0 5 1 4	' ⊠		
, 0 0 0 0 0 0 2	'	0,8	3 J 0 0 0 0 0	'	30 @ 10	
		0,9		'		
		1,0	Z 1 1 4 6			
, 0 0 0 0 0 0 1	'	1,1		' ⊠		
		1,2	Z 1 3 5 0	'		
, 0 0 0 0 0 0 2	'	1,3		'		
		1,4	2 0	'	1 @ 26	
		1,5	B 0 6 0 1	' ⊠	Z 0950	y > x
		1,6	Y 1 3 0 8	'		
		1,7	B 1 1 0 3	'	Z 1339	
		1,8	Y 1 3 1 0	'		
		1,9	B 1 1 0 5	' ⊠	Z 1128	
		2,0	Y 1 3 4 9	'		
		2,1	U 1 2 0 0	'		
		2,2	R 1 7 0 3	'	12.4	
		2,3	U 1 7 0 0	' ⊠		
		2,4	Z 0 9 2 7	'	t	
		2,5	x Z 0 1 1 0	'		
E X I T		2,6	U 0 4 0 2	'		
, 0 0 0 0 0 0 1	'	2,7		' ⊠		
		2,8	R 2 2 0 0	'	19.0	
		2,9	U 2 2 0 0	'		
, 0 0 0 0 0 0 2	'	3,0	2 0 1 8 1 0 0 2	'	C.R. C.S. u.c. Z	
		3,1	1 8 1 6 0 8 V Q	' ⊠	C.S. = l.c. EXIT	

CONDITIONAL STOP CODE   ⊠ CARRIAGE RETURN

D45228• McBEE TORONTO, CANADA
FORM f801

JOB NO. __MHRI__ PROG. NO. __F6-217__ PREP. BY __RAC__ CK'D. BY __L.K.__ DATE __12/20/60__

PROBLEM __FZt__ TRACK __11__

PROGRAM INPUT CODES	STOP	LOCATION	OP. INSTRUCTION ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	'					
	' ⊠					
		3 2	R 1 7 0 3	'	12.4	
		3 3	U 1 7 0 0	'		
		3 4	Z 0 9 4 9	'		
		3 5	x Z 0 1 1 0	' ⊠		
E X I T		3 6	U 0 4 0 2	'		
. 0 0 0 0 0 0 4	'	3 7		'		
		3 8				
		3 9		' ⊠		
		4 0		'		
		4 1	Z 0 5 1 4	'		
. 0 0 0 0 0 0 4	'	4 2		'		
		4 3		' ⊠		
		4 4		'		
		4 5		'		
		4 6	R 2 2 0 0	'	19.0	
		4 7	U 2 2 0 0	' ⊠		
. 0 0 0 0 0 0 8	'	4 8	2 0 1 0 4 J 0 8	'	CR UC (lc	
		4 9	4 A 0 6 2 2 3 2	'	X sp. i r	
		5 0	0 6 3 2 5 2 3 F	'	sp n u m	
		5 1	4 F 1 F 7 2 5 F	' ⊠	e r a t	
		5 2	4 6 1 F 0 6 4 6	'	o r sp. o	
		5 3	5 4 0 6 1 0 1 8	'	f sp. uc cs	
		5 4	5 4 1 8 0 4 0 8	'	F cs) lc	
		5 5	V Q 0 0 0 0 0 0	' ⊠	EXIT	
		5 6	x u [ ]	'		
, 0 0 0 0 0 0 4	'	5 7		'		
		5 8		'		
		5 9		' ⊠		
		6 0		'		
		6 1	Z 1 1 4 6	'		
, 0 0 0 0 0 0 1	'	6 2		'		
		6 3	Z 1 1 2 8	' ⊠		

CONDITIONAL STOP CODE   ⊠ CARRIAGE RETURN

D73876 MCBFE TORONTO, CANADA
FORM #802

JOB NO. __MHRI__ PROG. NO. __F6-217__ PREP. BY __RAC__ CK'D. BY __L.K.__ DATE __12/20/60__

PROBLEM __FZt__ TRACK __12__

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OP. ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	'			'		
	'	☒				
		0.0	R 2 2 0 0	'	19.0	
		0.1	U 2 2 0 0	'		
, 0 0 0 0 0 0 6	'	0.2	2 0 2 0 1 0 4 2	'	CR CR uc *P*	
		0.3	0 8 1 F 4 6 6 4	' ☒	lc r o j	
		0.4	4 F 6 F 5 F 0 6	'	e c t sp.	
		0.5	1 0 3 2 0 8 5 2	'	uc N lc u	
		0.6	3 F 0 F 4 F 1 F	'	m b e r	
		0.7	V Q 0 0 0 0 0 0	' ☒	EXIT	
		0.8	R 1 7 0 3	'	12.4	
		0.9	U 1 7 0 0	'		
		1.0	Z 0 4 5 3	'		
		1.1	x Z 0 1 2 7	' ☒		
		1.2	R 2 2 0 0	'	19.0	
		1.3	U 2 2 0 0	'		
, 0 0 0 0 0 0 3	'	1.4	2 0 1 0 3 2 0 8	'	CR UC N lc	
		1.5	4 A 1 0 1 6 0 8	' ☒	X UC = lc	
		1.6	V Q 0 0 0 0 0 0	'	EXIT	
		1.7	R 1 7 0 3	'	12.4	
		1.8	U 1 7 0 0	'		
		1.9	Z 0 9 4 5	' ☒		
		2.0	x Z 0 1 2 7	'		
		2.1	R 2 2 0 0	'	19.0	
		2.2	U 2 2 0 0	'		
, 0 0 0 0 0 0 3	'	2.3	2 0 1 0 3 2 0 8	' ☒	CR UC N lc	
		2.4	1 2 1 0 1 6 0 8	'	y UC = lc	
		2.5	V Q 0 0 0 0 0 0	'	EXIT	
		2.6	R 1 7 0 3	'	12.4	
		2.7	U 1 7 0 0	' ☒		
		2.8	Z 0 9 4 8	'		
		2.9	x Z 0 1 2 7	'		
		3.0	R 2 2 0 0	'	19.0	
		3.1	U 2 2 0 0	' ☒		

CONDITIONAL STOP CODE   ☒ CARRIAGE RETURN

JOB NO. **MHRI**   PROG. NO. **F6-217**   PREP. BY **RAC**   CK'D. BY **L.K.**   DATE **12/20/60**

PROBLEM **FZt**   TRACK **12**

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OP. ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	'					
	'	⊠				
, 0 0 0 0 0 0 3	'	3,2	2 0 1 0 3 F 0 8	'	CR uc	M lc
		3,3	4 A 1 0 1 6 0 8	'	x uc	= lc
		3,4	V Q 0 0 0 0 0 0	'	EXIT	
		3,5	R 1 7 0 3	' ⊠	12.4	
		3,6	U 1 7 0 0	'		
		3,7	Z 0 9 6 1	'	M_x	
		3,8	x Z 0 1 1 0	'		
		3,9	R 2 2 0 0	' ⊠	19.0	
		4,0	U 2 2 0 0	'		
, 0 0 0 0 0 0 3	'	4,1	2 0 1 0 3 F 0 8	'	CR uc	M lc
		4,2	1 2 1 0 1 6 0 8	'	y uc	= lc
		4,3	V Q 0 0 0 0 0 0	' ⊠	EXIT	
		4,4	R 1 7 0 3	'	12.4	
		4,5	U 1 7 0 0	'		
		4,6	Z 0 9 0 0	'	M_y	
		4,7	x Z 0 1 1 0	' ⊠		
		4,8	R 2 2 0 0	'	19.0	
		4,9	U 2 2 0 0	'		
, 0 0 0 0 0 0 3	'	5,0	2 0 1 0 7 F 0 8	'	CR uc	S lc
		5,1	4 A 1 0 1 6 0 8	' ⊠	X uc	= lc
		5,2	V Q 0 0 0 0 0 0	'	EXIT	
		5,3	R 1 7 0 3	'	12.4	
		5,4	U 1 7 0 0	'		
		5,5	Z 0 9 0 1	' ⊠	S_x	
		5,6	x Z 0 1 1 0	'		
		5,7	R 2 2 0 0	'	19.0	
		5,8	U 2 2 0 0	'		
, 0 0 0 0 0 0 3	'	5,9	2 0 1 0 7 F 0 8	' ⊠	CR uc	S lc
		6,0	1 2 1 0 1 6 0 8	'	y uc	= lc
		6,1	V Q 0 0 0 0 0 0	'	EXIT	
		6,2	R 1 7 0 3	'	12.4	
		6,3	U 1 7 0 0	' ⊠		

JOB NO. **MHRI** PROG. NO. **F6-217** PREP. BY **RAC** CK'D. BY **L. K.** DATE **12/20/60**

PROBLEM **FZt** TRACK **13**

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OP.	INSTRUCTION ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	'						
	'	☒					
		0,0	Z	0,5,6,2	'	S_y	
		0,1	x Z	0,1,1,0	'		
		0,2	R	2,2,0,0	'	19.0	
		0,3	U	2,2,0,0	' ☒		
, 0,0,0,0,0,0,2	'	0,4	2,0,1,8	1,0,5,4	'	CR CS UC F	
1c		0,5	1,8,1,6	0,8,V,Q	'	CS = 1c EXIT	
		0,6	R	1,7,0,3	'	12.4	
		0,7	U	1,7,0,0	' ☒		
		0,8	x Z	[, ,]	'	F	
		0,9	x Z	0,1,0,8	'		
		1,0	x U	[, ,]	'		
		1,1	B	1,1,6,1	' ☒	Z 1146	
		1,2	Y	1,3,1,0	'		
		1,3	B	1,1,6,3	'	Z 1126	
		1,4	Y	1,1,5,6	'		
		1,5	U	1,2,0,0	' ☒		
, 0,0,0,0,0,0,1,3	'	1,6			'		
		1,7			'		
		1,8			'		
		1,9	B	1,1,0,4	' ☒	Z 1146	
		2,0	Y	1,3,1,0	'		
		2,1	B	1,1,0,7	'	Z 0514	
		2,2	Y	1,1,5,6	'		
		2,3	U	1,2,0,0	' ☒		
		2,4	B	1,1,1,0	'	Z 1146	
		2,5	Y	1,3,1,0	'		
		2,6	B	1,1,1,2	'	Z 1350	
		2,7	Y	1,1,5,6	' ☒		
		2,8	U	1,2,0,0	'		
, 0,0,0,0,0,0,4	'	2,9			'		
		3,0			'		
		3,1			' ☒		

CONDITIONAL STOP CODE ' ☒ CARRIAGE RETURN

JOB NO. __MHRI__   PROG. NO. __F6-217__   PREP. BY __RAC__   CK'D. BY __L.K.__   DATE __12/20/60__

PROBLEM _____ FZt _____ TRACK __13__

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OP. / ADDRESS	STOP	CONTENTS OF ADDRESS			NOTES
	'							
	'	⊠						
		3 2		'				
		3 3	Z 1 3 5 0	'				
, 0 0 0 0 0 0 5	'	3 4		'				
		3 5		' ⊠				
		3 6		'				
		3 7		'				
		3 8		'				
		3 9	R 2 2 0 0	' ⊠	19.0			
		4 0	U 2 2 0 0	'				
, 0 0 0 0 0 0 8	'	4 1	2 0 1 0 4 J 0 8	'	CR	uc	(	lc
		4 2	1 2 0 6 2 2 3 2	'	y	sp.	i	n
		4 3	0 6 3 2 5 2 3 F	' ⊠	sp.	n	u	m
		4 4	4 F 1 F 7 2 5 F	'	e	r	a	t
		4 5	4 6 1 F 0 6 4 6	'	o	r	sp.	o
		4 6	5 4 0 6 1 0 1 8	'	f	sp.	uc	cs
		4 7	5 4 1 8 0 4 0 8	' ⊠	F	cs	)	lc
		4 8	V Q 0 0 0 0 0	'	EXIT			
		4 9	x U [ ]	'				
		5 0	R 2 2 0 0	'	19.0			
		5 1	U 2 2 0 0	' ⊠				
, 0 0 0 0 0 1 0	'	5 2	2 0 1 8 1 0 5 4	'	CR	cs	uc	F
		5 3	0 6 2 2 7 F 0 6	'	sp.	I	S	sp.
		5 4	7 F 2 2 5 J 3 2	'	S	I	G	N
		5 5	2 2 5 4 2 2 6 F	' ⊠	I	F	I	C
		5 6	7 2 3 2 5 F 0 6	'	A	N	T	sp.
		5 7	3 2 4 6 0 6 0 8	'	N	O	sp.	lc
		5 8	5 F 0 6 1 0 6 F	'	t	sp.	uc	C
		5 9	4 6 3 F 4 2 5 2	' ⊠	O	M	P	U
		6 0	5 F 4 F 2 F 1 8	'	T	E	D	cs
		6 1	0 8 V Q 0 0 0 0	'	lc	EXIT		
E X I T		6 2	U 0 4 0 2	'				
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CONDITIONAL STOP CODE   ⊠ CARRIAGE RETURN

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