PROGRAM DESCRIPTION:

Program Title: Sample Statistics Subroutine, ERFP

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Washington Operations

Purpose: To compute the sample mean, sample estimate of the variance and standard deviation; and standard error, and its square, of the mean.

Restrictions:

The subroutine makes use of the ERFP interpretive and square root subroutines. The observations within the sample must be stored sequentially. Storage of computed statistics is as follows:

Location	Statistic
L_o + 0105	n
L_o + 0107	$\sum x$
L_o + 0109	$\sum x^2$
L_o + 0111	$\bar{x} = \sum x/n$ (sample mean)
L_o + 0113	$d.f. = n - 1$ (degrees of freedom)
L_o + 0115	$S.S. = \sum (x - \bar{x})^2$ (sum of squares of deviations from the mean)
L_o + 0117	$s^2 = S.S./d.f.$ (sample estimate of the variance)
L_o + 0119	$s = \sqrt{s^2}$ (sample estimate of the standard deviation)
L_o + 0121	$s_{\bar{x}}^2 = s^2/n$ (sample estimate of the variance of the mean)
L_o + 0123	$s_{\bar{x}} = \sqrt{s_{\bar{x}}^2}$ (standard error of the mean)

Method:

Following storage of calling sequence information, n, Σx and Σx^2 are computed with a loop. Upon completion of loop operations the remainder of the statistics are computed and stored. The sum of squares of deviations from the mean is computed by the following equation

$$S.S. = \Sigma x^2 - \frac{(\Sigma x)^2}{n}$$

rather than by utilizing a second loop to compute square and sum deviations from the mean.
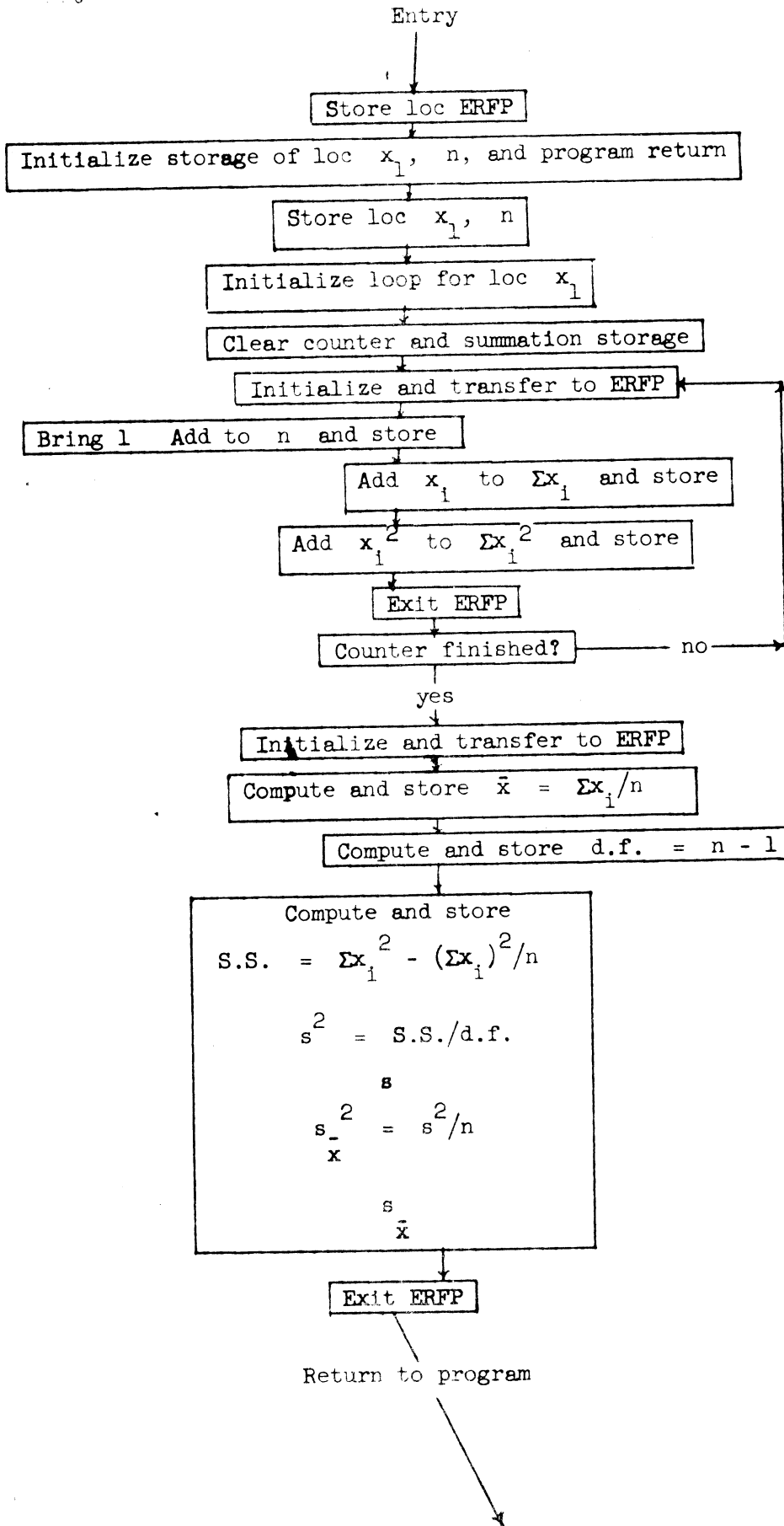
Coding Information:

Storage:

The subroutine requires 1 track and 45 sectors.

Calling Sequence:

Location	Operation	
α	R	L_0
$\alpha + 1$	U	L_0
$\alpha + 2$	Z	location of ERFP s.r.
$\alpha + 3$	Z	location of x_1 (first observation in the sample)
$\alpha + 4$	Z	n at $q = 29$
$\alpha + 5$	etc.	

Program No. F6-105 "Sample Statistics Subroutine, E.R.F.P."

by R.L.Stearman, Booz-Allen Applied Research Inc.,Bethesda, Md.

Entry

Store loc ERFP

Initialize storage of loc x_1, n, and program return

Store loc x_1, n

Initialize loop for loc x_1

Clear counter and summation storage

Initialize and transfer to ERFP

Bring 1 Add to n and store

Add x_i to Σx_i and store

Add x_i^2 to Σx_i^2 and store

Exit ERFP

Counter finished? ——— no

yes

Initialize and transfer to ERFP

Compute and store $\bar{x} = \Sigma x_i / n$

Compute and store d.f. = n - 1

Compute and store

$$S.S. = \Sigma x_i^2 - (\Sigma x_i)^2 / n$$

$$s^2 = S.S./d.f.$$

s

$$s_{\bar{x}}^2 = s^2 / n$$

$$s_{\bar{x}}$$

Exit ERFP

Return to program

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PROBLEM:	SAMPLE STATISTICS SUBROUTINE, ERFP		TRACK	

PROGRAM INPUT CODES	STOP	LOCATION	OPERATION	ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
; 0 0 0 L0	'						
/ 0 0 0 L0	'	⊠					
		0 0	x b	0 0 0 0	'		store loc ERFP
		0 1	y	0 1 0 0	'		
		0 2	b	0 0 0 0	'	loc x1	initialization
		0 3	a	0 1 0 4	'	⊠	
		0 4	y	0 0 0 9	'		
		0 5	a	0 1 0 4	'	n	
		0 6	y	0 0 1 1	'		
		0 7	a	0 1 0 4	'	⊠ prgm.return	
		0 8	y	0 1 3 7	'		
		0 9	x b	0 0 0 0	'	loc x1	store loc x1 and n
		1 0	y	0 1 0 1	'		
		1 1	x b	0 0 0 0	'	⊠ n	
		1 2	y	0 1 0 2	'		
		1 3	b	0 1 0 1	'	loc x1	initialize loop
		1 4	y	0 0 3 3	'		
		1 5	y	0 0 3 6	'	⊠	
		1 6	y	0 0 3 7	·		
		1 7	x c	6 3 6 3	'	junk	clear counter & summa-
		1 8	c	0 1 2 5	'	counter	tion storage
		1 9	c	0 1 0 5	'	⊠ n	
		2 0	c	0 1 0 6	'		
		2 1	c	0 1 0 7	'	Σ x	
		2 2	c	0 1 0 8	'		
		2 3	c	0 1 0 9	'	⊠ Σx sq.	
		2 4	c	0 1 1 0	'		
		2 5	b	0 1 0 0	'		initialize ERFP
		2 6	y	0 0 2 9	'		
		2 7	y	0 0 2 8	'	⊠	
		2 8	x r	0 0 0 0	'		to ERFP
		2 9	x v	0 0 0 0	'		
		3 0	8 0 0 b	0 1 0 3	'	1	n
		3 1	8 0 0 a	0 1 0 5	·	⊠ n	

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⊠ CARRIAGE RETURN

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JOB NO.	PROGRAM NO.	PROGRAM PREPARED BY:	PROGRAM CHECKED BY:	DATE
	F6-105	R. L. Stearman	POOL Review	3/29/60

PROBLEM:	TRACK
SAMPLE STATISTICS SUBROUTINE, ERFP	

PROGRAM INPUT CODES	STOP	LOCATION	OPERATION	ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	'						
	'	⊠					
		0032	8 0 0 c	0 1 0 5	'	n	n
		33	8 0 x b	0 0 0 0	'	x	Σx
		34	8 0 0 a	0 1 0 7	'	Σx	
		35	8 0 0 c	0 3 0 7	⊠	n	
		36	8 0 x f	0 0 0 0	'	x	Σx sq.
		37	8 0 x m	0 0 0 0	'		
		38	8 0 0 a	0 2 0 9	'	Σx sq.	
		39	8 0 0 c	0 2 0 9	⊠		
		40	x e	0 0 0 0	'		exit ERFP
		41	b	0 1 2 5	'	counter	counter
		42	a	0 1 0 4	'	1	
		43	h	0 1 2 5	⊠	counter	
		44	s	0 1 0 2	'	n	
		45	t	0 1 3 8	'	loop	
		46	b	0 1 0 0	'		initialize ERFP
		47	y	0 9 5 0	⊠		
		48	y	0 0 4 9	'		
		49	x r	0 0 0 0	'		to ERFP
		50	x u	0 0 0 0	'		
		51	8 0 0 b	0 1 0 7	⊠	Σx	mean
		52	8 0 0 d	0 1 0 5	'	n	
		53	8 0 0 c	0 1 1 1	'	mean	
		54	8 0 0 b	0 1 0 5	⊠	n	d.f.
		55	8 0 0 s	0 1 0 3	'	1	
		56	8 0 0 c	0 1 1 3	'	d.f.	
		57	8 0 0 p	0 1 0 7	'	Σx	S.S.
		58	8 0 0 m	0 1 0 7	'		
		59	8 0 0 d	0 1 0 5	⊠	n	
		60	8 0 0 c	0 1 1 5	'	temp.(Σx) sq./n	
		61	8 0 0 b	0 1 0 9	'	Σx sq.	
		62	8 0 0 s	0 1 1 5	'	temp.(Σx) sq./n	
		63	u	0 1 2 6	⊠	around storage	

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⊠ = CARRIAGE RETURN

' = CONDITIONAL STOP CODE

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PROBLEM:	SAMPLE STATISTICS SUBROUTINE, KRFP		TRACK

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OPERATION	INSTRUCTION ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	'						
	'	⊠					
, 0 0, 0 0, 0 2 5	'	0 1 0 0			'	loc KRFP	storage
		0 1			'	loc x1	
		0 2			'	n	
		0 3	4 0 0 0	0 0 0 0	' ⊠	1	
		0 4		4	'		
		0 5			'	n	
		0 6			'		
		0 7			' ⊠	$\sum x$	
		0 8					
		0 9			'	$\sum x$ sq.	
		1 0					
		1 1			' ⊠	mean	
		1 2			'		
		1 3			'	d.f.	
		1 4					
		1 5			' ⊠	S.S.	
		1 6			•		
		1 7			'	variance	
		1 8					
		1 9			' ⊠	s	(std. dev.)
		2 0			'		
		2 1			'	v(mean)	(variance of mean)
		2 2			'		
		2 3			' ⊠	s(mean)	(std. error of mean)
		2 4			'		
		2 5			'	counter	
		2 6	8 0 0 h	0 1 1 5	'	S.S.	S.S. (from 0061)
		2 7	8 0 0 d	0 1 1 3	' ⊠	d.f.	variance
		2 8	8 0 0 h	0 1 1 7	'	v.	
		2 9	x r	0 0 0 0	'	sq. root	s
		3 0	8 0 0 c	0 1 1 9	'	s	
		3 1	8 0 0 b	0 1 1 7	⊠	v	v(mean)

⊠ CARRIAGE RETURN

• = CONDITIONAL STOP CODE

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PROBLEM: SAMPLE STATISTICS SUBROUTINE, ERFP				TRACK

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OPERATION	INSTRUCTION ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	'						
	'	⊠					
		01312	8 00d	01 05	'	n	v(mean) = variance/n
		33	8 00h	01 21	'	v	
		34	x r	00 00	'	sq. root	s(mean)
		35	8 00c	01 23	'	⊠ s(mean)	
		36	x e	00 00	'		exit ERFP
		37	x u	00 00	'	return to program	
		38	b	00 33	'		modify loop address
		39	a	01 44	'	⊠	
		40	y	00 33	'		
		41	y	00 36	'		
		42	y	00 37	'		
		43	u	00 28	'	⊠ to new x	
		44	x z	00 02	'	2 at 29	
		45			'		
		46			'	⊠	
		47			'		
		48			'		
		49			'		
		50			'	⊠	
		51			'		
		52			'		
		53			'		
		54			'		
		55			'	⊠	
		56			'		
		57			'		
		58			'	⊠	
		59			'		
		60			'		
		61			'		
		62			'		
		63			'	⊠	

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⊠ CARRIAGE RETURN