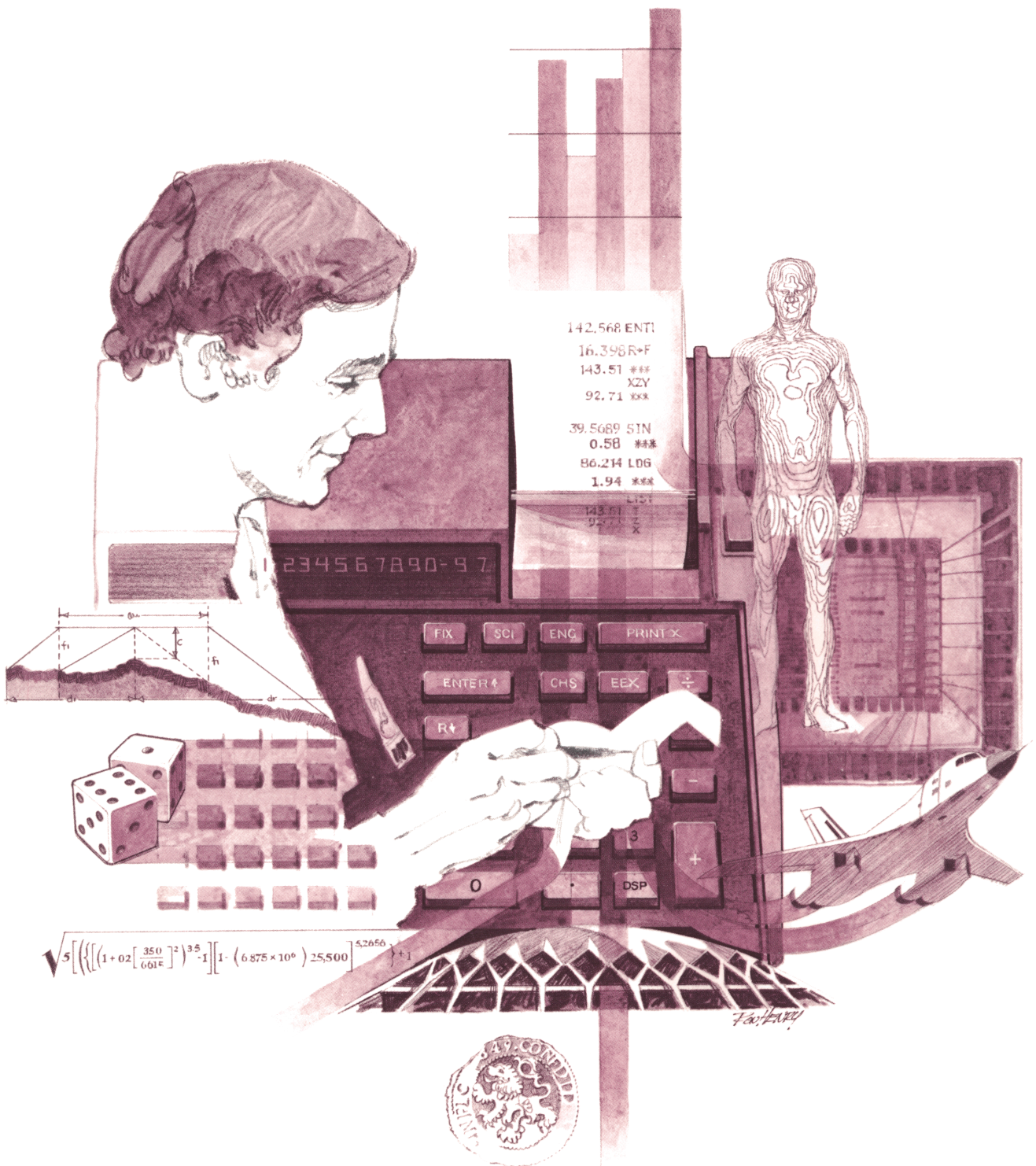


HEWLETT-PACKARD

HP-67/HP-97

Users' Library Solutions

Test Statistics



INTRODUCTION

In an effort to provide continued value to its customers, Hewlett-Packard is introducing a unique service for the HP fully programmable calculator user. This service is designed to save you time and programming effort. As users are aware, Programmable Calculators are capable of delivering tremendous problem solving potential in terms of power and flexibility, but the real genie in the bottle is program solutions. HP's introduction of the first handheld programmable calculator in 1974 immediately led to a request for program **solutions** — hence the beginning of the HP-65 Users' Library. In order to save HP calculator customers time, users wrote their own programs and sent them to the Library for the benefit of other program users. In a short period of time over 5,000 programs were accepted and made available. This overwhelming response indicated the value of the program library and a Users' Library was then established for the HP-67/97 users.

To extend the value of the Users' Library, Hewlett-Packard is introducing a unique service—a service designed to save you time and money. The Users' Library has collected the best programs in the most popular categories from the HP-67/97 and HP-65 Libraries. These programs have been packaged into a series of low-cost books, resulting in substantial savings for our valued HP-67/97 users.

We feel this new software service will extend the capabilities of our programmable calculators and provide a great benefit to our HP-67/97 users.

A WORD ABOUT PROGRAM USAGE

Each program contained herein is reproduced on the standard forms used by the Users' Library. Magnetic cards are not included. The Program Description I page gives a basic description of the program. The Program Description II page provides a sample problem and the keystrokes used to solve it. The User Instructions page contains a description of the keystrokes used to solve problems in general and the options which are available to the user. The Program Listing I and Program Listing II pages list the program steps necessary to operate the calculator. The comments, listed next to the steps, describe the reason for a step or group of steps. Other pertinent information about data register contents, uses of labels and flags and the initial calculator status mode is also found on these pages. Following the directions in your HP-67 or HP-97 **Owners' Handbook and Programming Guide**, "Loading a Program" (page 134, HP-67; page 119, HP-97), key in the program from the Program Listing I and Program Listing II pages. A number at the top of the Program Listing indicates on which calculator the program was written (HP-67 or HP-97). If the calculator indicated differs from the calculator you will be using, consult Appendix E of your **Owner's Handbook** for the corresponding keycodes and keystrokes converting HP-67 to HP-97 keycodes and vice versa. No program conversion is necessary. The HP-67 and HP-97 are totally compatible, but some differences do occur in the keycodes used to represent some of the functions.

A program loaded into the HP-67 or HP-97 is not permanent—once the calculator is turned off, the program will not be retained. You can, however, permanently save any program by recording it on a blank magnetic card, several of which were provided in the Standard Pac that was shipped with your calculator. Consult your **Owner's Handbook** for full instructions. A few points to remember:

The Set Status section indicates the status of flags, angular mode, and display setting. After keying in your program, review the status section and set the conditions as indicated before using or permanently recording the program.

REMEMBER! To save the program permanently, **clip** the corners of the magnetic card once you have recorded the program. This simple step will protect the magnetic card and keep the program from being inadvertently erased.

As a part of HP's continuing effort to provide value to our customers, we hope you will enjoy our newest concept.

TABLE OF CONTENTS

ONE SAMPLE TEST STATISTICS FOR THE MEAN	1
Computes the z statistic for testing the mean if the variance is known. If the variance is unknown, then the t statistic is computed.	
TEST STATISTICS FOR THE CORRELATION COEFFICIENT.	5
The t statistic can be used to test if the true correlation coefficient is zero. The z statistic, which can be used to test if the correlation coefficient equals a given number (usually non-zero) is also computed.	
DIFFERENCES AMONG PROPORTIONS	9
Computes the chi-square statistic for testing if several independent binomial distributions have equal means.	
BEHRENS-FISHER STATISTIC	13
Given random samples from two independent normal populations with unequal variances (unknown), this program computes the Behren-Fisher statistic for testing the means.	
KRUSKAL-WALLIS STATISTIC	17
The Kruskal-Wallis statistic can be used to test if the independent random samples come from identical continuous population	
MEAN-SQUARE SUCCESSIVE	23
The mean-square successive difference is used to test if a given sample is random. Suppose the sample size is large and the population is normal, then a z statistic is used instead.	
THE RUN TEST FOR RANDOMNESS.	27
For a given sequence, the z statistic is computed for testing the randomness of the sequence.	
INTRACLASS CORRELATION COEFFICIENT	32
Calculates the intraclass correlation coefficient which measures the degree of association among individuals within classes or groups.	
FISHER'S EXACT TEST FOR A 2 X 2 CONTINGENCY TABLE.	37
Fisher's exact probability test is used to analyze a 2 x 2 contingency table when the two independent samples are small in size.	
BARTLETT'S CHI-SQUARE STATISTIC	42
This chi-square statistic can be used to test the homogeneity of variances. Error corrector for erroneous input data is provided.	
MANN-WHITNEY STATISTIC	46
Computes the Mann-Whitney statistic on two independent samples of equal or unequal sizes. Error corrector for erroneous input data is provided.	
KENDALL'S COEFFICIENT OF CONCORDANCE	50
Calculates Kendall's coefficient of concordance to test agreement between rankings. Error corrector for erroneous input data is provided.	

Program Description I

Program Title	ONE SAMPLE TEST STATISTICS FOR THE MEAN		
Contributor's Name	Hewlett-Packard		
Address	1000 N.E. Circle Blvd.		
City	Corvallis	State	Oregon
		Zip Code	97330

Program Description, Equations, Variables

Suppose $\{x_1, x_2, \dots, x_n\}$ is a sample from a normal population with a known variance σ^2 and unknown mean μ . A test of the null hypothesis

$$H_0: \mu = \mu_0$$

is based on the z statistic which has a standard normal distribution.

If the variance σ^2 is unknown then the t statistic, which has the t distribution with $n - 1$ degrees of freedom, is used instead.

Equations:

$$z = \frac{\sqrt{n}(\bar{x} - \mu_0)}{\sigma}$$

$$t = \frac{\sqrt{n}(\bar{x} - \mu_0)}{s}$$

where \bar{x} and s are sample mean and sample standard deviation.

Operating Limits and Warnings

Remark:

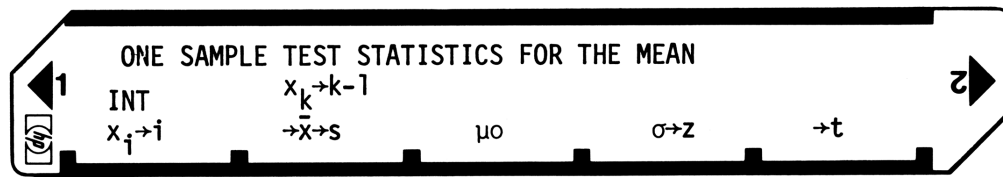
$$n > 1.$$

This program has been verified only with respect to the numerical example given in *Program Description II*. User accepts and uses this program material AT HIS OWN RISK, in reliance solely upon his own inspection of the program material and without reliance upon any representation or description concerning the program material.

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User Instructions

3



STEP	INSTRUCTIONS	INPUT DATA/UNITS	KEYS	OUTPUT DATA/UNITS
1	Enter program		<input type="text"/> <input type="text"/>	
2	If \bar{x} and s are known, go to 8		<input type="text"/> <input type="text"/>	
3	Initialize		RTN <input type="text"/> R/S <input type="text"/>	0.00
4	Perform 4 for $i = 1, 2, \dots, n$	x_i	A <input type="text"/>	i
5	Optional—delete erroneous data x_k ($k \neq 1$)	x_k	<input type="text"/> <input type="text"/>	
			f <input type="text"/> A <input type="text"/>	
			<input type="text"/> <input type="text"/>	
6	Compute \bar{x} and s		B <input type="text"/>	\bar{x}
			B <input type="text"/>	s
7	Go to 9		<input type="text"/> <input type="text"/>	
8	Store \bar{x} and s	\bar{x}	STO <input type="text"/> 2 <input type="text"/>	
		s	STO <input type="text"/> 5 <input type="text"/>	
9	Input μ_0	μ_0	C <input type="text"/>	
10	Input σ and compute z	σ	D <input type="text"/>	z
	or		<input type="text"/> <input type="text"/>	
	Compute t		E <input type="text"/>	t
11	For a new case, go to 2		<input type="text"/> <input type="text"/>	

STEP	KEY ENTRY	KEY CODE	COMMENTS	STEP	KEY ENTRY	KEY CODE	COMMENTS	
001	*LBLA	21 16 11	Initialize	057	-	-45	$\bar{x}-\mu_0$	
002	CLRG	16-53		058	X \div Y	-41		
003	RTN	24		059	=	-24		
004	*LBLA	21 11		060	RCL1	36 01		
005	RCL2	36 02		061	JX	54		
006	-	-45		062	X	-35		
007	RCL4	36 04		063	RTN	24		
008	-	-45		064	*LBLB	21 15		
009	RCL1	36 01		065	RCL2	36 02		
010	1	01		066	RCL6	36 06		
011	+	-55	Accumulate sums for the mean and the standard deviation	067	-	-45	$\bar{x}-\mu_0$	
012	=	-24		068	RCL5	36 05		
013	ENT \uparrow	-21		069	=	-24		
014	ENT \uparrow	-21		070	RCL1	36 01		
015	RCL4	36 04		071	JX	54		
016	+	-55		072	X	-35		
017	ENT \uparrow	-21		073	RTN	24		
018	ENT \uparrow	-21		074	*LBLb	21 16 12		
019	RCL2	36 02		075	RCL1	36 01		
020	+	-55		076	CHS	-22		
021	STO2	35 02	Display z	077	STO1	35 01	Display t	
022	LSTX	16-63		078	R \downarrow	-31		
023	-	-45		079	GSBA	23 11		
024	-	-45		080	R/S	51		
025	STO4	35 04						
026	R \downarrow	-31						
027	X	-35						
028	RCL1	36 01						
029	X	-35						
030	1	01						
031	LSTX	16-63						
032	+	-55						
033	ABS	16 31						
034	STO1	35 01						
035	X	-35						
036	ST+3	35-55 03						
037	RCL1	36 01						
038	RTN	24						
039	*LBLB	21 12	Display the mean					
040	RCL2	36 02						
041	R/S	51						
042	*LBLB	21 12						
043	RCL3	36 03						
044	RCL1	36 01						
045	1	01						
046	-	-45						
047	=	-24						
048	JX	54						
049	STO5	35 05	Store s					
050	RTN	24						
051	*LBLC	21 13						
052	STO6	35 06						
053	RTN	24						
054	*LBLD	21 14						
055	RCL2	36 02						
056	RCL6	36 06						

Program Description I

Program Title **TEST STATISTICS FOR THE CORRELATION COEFFICIENT**
 Contributor's Name **Hewlett-Packard**
 Address **1000 N.E. Circle Blvd.**
 City **Corvallis** State **Oregon** Zip Code **97330**

Program Description, Equations, Variables

Under the assumptions of normal correlation analysis, the t statistic, which has the t distribution with $n - 2$ degrees of freedom, can be used to test the null hypothesis that the true correlation coefficient $\rho = 0$.

To test the null hypothesis $\rho = \rho_0$, where ρ_0 is a given number, the z statistic is used. z has approximately the standard normal distribution.

Equations:

$$t = \frac{r\sqrt{n-2}}{\sqrt{1-r^2}}$$

$$z = \frac{\sqrt{n-3}}{2} \ln \left[\frac{(1+r)(1-\rho_0)}{(1-r)(1+\rho_0)} \right]$$

where r is an estimate (based on a sample of size n) of the correlation coefficient ρ .

Operating Limits and Warnings

Remarks:

1. This program requires that $n > 3$, $|r| < 1$ and $|\rho_0| < 1$; otherwise, flashing zeros will result.
2. Usually, the z statistic is used when the sample size is large.

This program has been verified only with respect to the numerical example given in *Program Description II*. User accepts and uses this program material AT HIS OWN RISK, in reliance solely upon his own inspection of the program material and without reliance upon any representation or description concerning the program material.

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[illegible]

Sample Problem(s)

Example:

Given $r = 0.12$, $n = 31$, and $\rho_0 = 0$, find t and z .

Keystrokes:

.12 **A** 31 **B** **C** \longrightarrow 0.65 (t)

0 **D** **E** \longrightarrow 0.64 (z)

[illegible]

Reference(s)

1. Hogg and Craig, Introduction to Mathematical Statistics, Macmillan Co., 1970.
2. J. Freund, Mathematical Statistics, Prentice-Hall, 1971.
3. This program is a translation of the HP-65 Stat Pac 2 program.

User Instructions

7

TEST STATISTICS FOR THE
CORRELATION COEFFICIENT

r n $\rightarrow t$ ρ_0 $\rightarrow z$

STEP	INSTRUCTIONS	INPUT DATA/UNITS	KEYS	OUTPUT DATA/UNITS
1	Enter program		<input type="text"/> <input type="text"/>	
2	Input r and n in any order	r	<input type="text"/> A <input type="text"/>	
		n	<input type="text"/> B <input type="text"/>	
3	Compute t		<input type="text"/> C <input type="text"/>	t
	or		<input type="text"/> <input type="text"/>	
	Input ρ_0 and compute z	ρ_0	<input type="text"/> D <input type="text"/>	
			<input type="text"/> E <input type="text"/>	z
4	For a new case, go to 2		<input type="text"/> <input type="text"/>	

97 Program Listing I

STEP	KEY ENTRY	KEY CODE	COMMENTS	STEP	KEY ENTRY	KEY CODE	COMMENTS
001	*LBLA	21 11	Store r Test if r or ρ_0 has absolute value less than or equal to 1	057	=	-24	
002	STO1	35 01		058	RTN	24	
003	*LBLB	21 00		060			
004	ABS	16 31					
005	1	01					
006	X \neq Y	-41					
007	X>Y?	16-34					
008	GT09	22 09					
009	LSTX	16-63					
010	RTN	24					
011	*LBLB	21 12	Store n Test if n > 3	070			
012	STO2	35 02					
013	3	03					
014	X \neq Y	-41					
015	X \leq Y?	16-35					
016	GT09	22 09					
017	RTN	24					
018	*LBLC	21 13					
019	RCL2	36 02					
020	2	02					
021	-	-45	n-2 (n-2)/(1-r ²)	080			
022	1	01					
023	RCL1	36 01					
024	X ²	53					
025	-	-45					
026	=	-24					
027	JX	54					
028	RCL1	36 01					
029	x	-35					
030	RTN	24					
031	*LBLD	21 14	Store ρ_0 Test if $ \rho_0 \leq 1$ Compute z (1+4)/(1-r)	090			
032	STO3	35 03					
033	GT00	22 00					
034	*LBLE	21 15					
035	RCL1	36 01					
036	1	01					
037	+	-55					
038	1	01					
039	RCL1	36 01					
040	-	-45					
041	=	-24	n-3	100			
042	1	01					
043	RCL3	36 03					
044	-	-45					
045	x	-35					
046	1	01					
047	RCL3	36 03					
048	+	-55					
049	=	-24					
050	LN	32					
051	RCL2	36 02		110			
052	3	03					
053	-	-45					
054	JX	54					
055	x	-35					
056	2	02					

SET STATUS

FLAGS		TRIG	DISP
ON	OFF		
0	<input checked="" type="checkbox"/>	DEG <input checked="" type="checkbox"/>	FIX <input checked="" type="checkbox"/>
1	<input type="checkbox"/>	GRAD <input type="checkbox"/>	SCI <input type="checkbox"/>
2	<input checked="" type="checkbox"/>	RAD <input type="checkbox"/>	ENG <input type="checkbox"/>
3	<input checked="" type="checkbox"/>		n <u>2</u>

REGISTERS

0	1	2	3	4	5	6	7	8	9
S0	S1	S2	S3	S4	S5	S6	S7	S8	S9
A	B	C	D	E	I				

Program Description I

Program Title	DIFFERENCES AMONG PROPORTIONS		
Contributor's Name	Hewlett-Packard		
Address	1000 N.E. Circle Blvd.		
City	Corvallis	State	Oregon
		Zip Code	97330

Program Description, Equations, Variables

Suppose x_1, x_2, \dots, x_k are observed values of a set of independent random variables having binomial distributions with parameters n_i and θ_i ($i = 1, 2, \dots, k$).

A chi-square statistic χ^2 can be used to test the null hypothesis $\theta_1 = \theta_2 = \dots = \theta_k$. The χ^2 statistic has the chi-square distribution with $k - 1$ degrees of freedom.

Equation:

$$\chi^2 = \sum_{i=1}^k \frac{(x_i - n_i \hat{\theta})^2}{n_i \hat{\theta} (1 - \hat{\theta})} = \sum_{i=1}^k n_i \left[\frac{1}{\sum_{i=1}^k x_i} \sum_{i=1}^k \frac{x_i^2}{n_i} + \frac{1}{\sum_{i=1}^k (n_i - x_i)} \sum_{i=1}^k \frac{(n_i - x_i)^2}{n_i} - 1 \right]$$

where

$$\hat{\theta} = \frac{\sum_{i=1}^k x_i}{\sum_{i=1}^k n_i}$$

Operating Limits and Warnings

This program has been verified only with respect to the numerical example given in *Program Description II*. User accepts and uses this program material AT HIS OWN RISK, in reliance solely upon his own inspection of the program material and without reliance upon any representation or description concerning the program material.

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Program Description II

[illegible]

Sample Problem(s)														
<p>Example:</p> <table border="1"> <thead> <tr> <th></th> <th>n_i</th> <th>x_i</th> </tr> </thead> <tbody> <tr> <td>Sample 1</td> <td>400</td> <td>232</td> </tr> <tr> <td>Sample 2</td> <td>500</td> <td>260</td> </tr> <tr> <td>Sample 3</td> <td>400</td> <td>197</td> </tr> </tbody> </table> <p>Keystrokes:</p> <p>A 400 ↓ 232 B 500 ↓ 260 B 400 ↓ 197 B → 3.00 (k)</p> <p>C → 6.47 (χ^2)</p> <p>D → 2.00 (df)</p> <p>E → 0.53 ($\hat{\theta}$)</p>				n_i	x_i	Sample 1	400	232	Sample 2	500	260	Sample 3	400	197
	n_i	x_i												
Sample 1	400	232												
Sample 2	500	260												
Sample 3	400	197												
<p>Solution(s)</p>														

Reference(s) 1. J. Freund, Mathematical Statistics, Prentice-Hall, 1971.
2. This program is a translation of the HP-65 Stat Pac 2 program.

User Instructions



DIFFERENCES
AMONG PROPORTIONS

INIT $n_i \leftrightarrow x_i \triangleright i$ $\triangleright \chi^2$ $\triangleright df$ $\triangleright \hat{\theta}$

STEP	INSTRUCTIONS	INPUT DATA/UNITS	KEYS	OUTPUT DATA/UNITS
1	Enter program		<div></div> <div></div>	
2	Initialize		<div>A</div> <div></div>	0.00
3	Perform 3 for $i = 1, 2, \dots, k$	n_i	<div>↑</div> <div></div>	
		x_i	<div>B</div> <div></div>	i
4	Compute χ^2 statistic		<div>C</div> <div></div>	χ^2
5	Compute df		<div>D</div> <div></div>	df
6	Compute $\hat{\theta}$		<div>E</div> <div></div>	$\hat{\theta}$
7	For a new case, go to 2		<div></div> <div></div>	

97 Program Listing I

12 STEP	KEY ENTRY	KEY CODE	COMMENTS	STEP	KEY ENTRY	KEY CODE	COMMENTS
001	*LBLA	21 11	Initialize				
002	CLRG	16-53					
003	0	00		060			
004	RTN	24					
005	*LBLB	21 12	Accumulate sums $n_i - x_i$				
006	ST+1	35-55 01					
007	-	-45					
008	ST04	35 04					
009	ST+2	35-55 02					
010	LSTX	16-63					
011	+	-55					
012	LSTX	16-63					
013	ENT↑	-21		070			
014	X	-35					
015	X≠Y	-41	x_i^2 x_i^2/n_i n_i $(n_i - x_i)^2$				
016	÷	-24					
017	ST+5	35-55 05					
018	LSTX	16-63					
019	RCL4	36 04					
020	ENT↑	-21					
021	X	-35					
022	X≠Y	-41					
023	÷	-24		080			
024	ST+6	35-55 06					
025	1	01	Compute χ^2				
026	RCL3	36 03					
027	+	-55					
028	ST03	35 03					
029	RTN	24					
030	*LBLC	21 13					
031	RCL5	36 05					
032	RCL1	36 01					
033	÷	-24		090			
034	RCL6	36 06					
035	RCL2	36 02	Compute df				
036	÷	-24					
037	+	-55					
038	1	01					
039	-	-45					
040	RCL1	36 01					
041	RCL2	36 02					
042	+	-55					
043	X	-35		100			
044	RTN	24					
045	*LBLD	21 14	Compute θ				
046	RCL3	36 03					
047	1	01					
048	-	-45					
049	RTN	24					
050	*LBLE	21 15					
051	RCL1	36 01					
052	RCL1	36 01					
053	RCL2	36 02		110			
054	+	-55					
055	÷	-24					
056	RTN	24					

SET STATUS		
FLAGS	TRIG	DISP
ON OFF		
0 <input type="checkbox"/> <input checked="" type="checkbox"/>	DEG <input checked="" type="checkbox"/>	FIX <input checked="" type="checkbox"/>
1 <input type="checkbox"/> <input checked="" type="checkbox"/>	GRAD <input type="checkbox"/>	SCI <input type="checkbox"/>
2 <input type="checkbox"/> <input checked="" type="checkbox"/>	RAD <input type="checkbox"/>	ENG <input type="checkbox"/>
3 <input type="checkbox"/> <input checked="" type="checkbox"/>		n <u>2</u>

REGISTERS								
0	1 Σx_i	2 $\Sigma (n_i - x_i)$	3 k	4 $n_i - x_i$	5 $\Sigma (x_i^2/n_i)$	6 $\Sigma (n_i - x_i)^2/n_i$	7	8
S0	S1	S2	S3	S4	S5	S6	S7	S8
A	B	C	D	E	I			

Program Description I

Program Title

BEHRENS-FISHER STATISTIC

Contributor's Name Hewlett-Packard

Address 1000 N.E. Circle Blvd.

City Corvallis

State Oregon

Zip Code 97330

Program Description, Equations, Variables

Suppose $\{x_1, x_2, \dots, x_{n_1}\}$ and $\{y_1, y_2, \dots, y_{n_2}\}$ are independent random samples from two normal populations having means μ_1, μ_2 (unknown). If the variances σ_1^2, σ_2^2 cannot be assumed equal, then the Behrens-Fisher statistic d is used instead of the t statistic to test the null hypothesis

$$H_0: \mu_1 - \mu_2 = D.$$

Equation:

$$d = \frac{\bar{x} - \bar{y} - D}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$$

where \bar{x}, \bar{y} and s_1^2, s_2^2 are sample means and variances.

Critical values of this test are tabulated in the Fisher-Yates Tables for various values of n_1, n_2, α and θ , where α is the level of significance and

$$\theta = \tan^{-1} \left(\frac{s_1}{s_2} \sqrt{\frac{n_2}{n_1}} \right).$$

Operating Limits and Warnings

Remark:

$$n_1 > 1, n_2 > 1.$$

This program has been verified only with respect to the numerical example given in *Program Description II*. User accepts and uses this program material AT HIS OWN RISK, in reliance solely upon his own inspection of the program material and without reliance upon any representation or description concerning the program material.

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Program Description II

[illegible]

Sample Problem(s)

Example:
 Compute the Behrens-Fisher statistic for $D = 0$.

x: 79, 84, 108, 114, 120, 103, 122, 120
 y: 91, 103, 90, 113, 108, 87, 100, 80, 99, 54

Keystrokes:

[f] [A] 79 [A] 84 [A] ... 120 [A]	→	8.00 (n_1)
B	→	34.60 (s_1^2/n_1)
[f] [A] 91 [A] 103 [A] ... 54 [A]	→	10.00 (n_2)
0 [C] [D]	→	1.73 (d)
E	→	47.88° (θ) or 0.84 radians or 53.20 grads

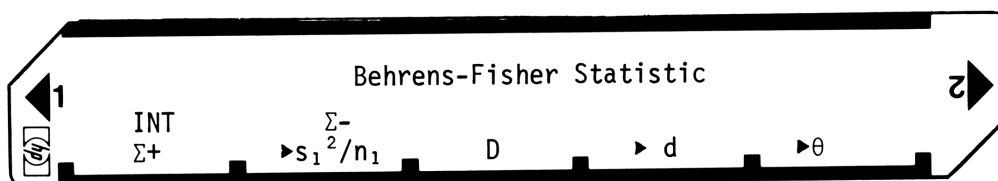
Solution(s)

Reference(s) 1. Fisher and Yates, Statistical Tables for Biological, Agricultural and Medical Research, Hafner, Publishing Co., 1970.

2. This program is a translation of the HP-65 Stat Pac 2 program.

User Instructions

15



STEP	INSTRUCTIONS	INPUT DATA/UNITS	KEYS	OUTPUT DATA/UNITS
1	Enter program		<input type="text"/> <input type="text"/>	
2	If \bar{x} , \bar{y} and s_1 , s_2 are known, go		<input type="text"/> <input type="text"/>	
	to 11		<input type="text"/> <input type="text"/>	
3	Initialize		<input type="text"/> f <input type="text"/> A	0.00
4	Perform 4 for $i = 1, 2, \dots, n_1$	x_i	<input type="text"/> A <input type="text"/>	i
5	Optional—delete erroneous x_k	x_k	<input type="text"/> f <input type="text"/> B	
	($k \neq 1$)		<input type="text"/> <input type="text"/>	
6	Compute and store \bar{x} , s_1^2/n_1		<input type="text"/> B <input type="text"/>	s_1^2/n_1
7	Initialize		<input type="text"/> f <input type="text"/> A	0.00
8	Perform 8 for $i = 1, 2, \dots, n_2$	y_i	<input type="text"/> A <input type="text"/>	i
9	Optional—delete erroneous y_h	y_h	<input type="text"/> f <input type="text"/> B	
	($h \neq 1$)		<input type="text"/> <input type="text"/>	
10	Go to 12		<input type="text"/> <input type="text"/>	
11	Store \bar{x} , \bar{y} and s_1^2/n_1 , s_2^2/n_2		<input type="text"/> <input type="text"/>	
	in any order	\bar{x}	<input type="text"/> STO <input type="text"/> 5	
		s_1^2/n_1	<input type="text"/> STO <input type="text"/> 6	
		\bar{y}	<input type="text"/> STO <input type="text"/> 2	
		s_2^2/n_2	<input type="text"/> STO <input type="text"/> 3	
12	Input D	D	<input type="text"/> C <input type="text"/>	
13	Compute d and θ		<input type="text"/> D <input type="text"/>	d
			<input type="text"/> E <input type="text"/>	θ
14	Optional—recall means		<input type="text"/> RCL <input type="text"/> 5	\bar{x}
			<input type="text"/> RCL <input type="text"/> 2	\bar{y}
15	For a different D, go to 12		<input type="text"/> <input type="text"/>	
16	For a new case, go to 2		<input type="text"/> <input type="text"/>	

97 Program Listing I

STEP	KEY ENTRY	KEY CODE	COMMENTS	STEP	KEY ENTRY	KEY CODE	COMMENTS		
001	*LBLA	21 16 11	Initialize	057	RTN	24	Compute d		
002	0	00		058	*LBLD	21 14			
003	STO1	35 01		059	RCL5	36 05			
004	STO2	35 02		060	RCL2	36 02			
005	STO3	35 03		061	-	-45			
006	STO4	35 04		062	RCL7	36 07			
007	RTN	24		063	-	-45			
008	*LBLA	21 11	Accumulate sums	064	RCL3	36 03	Store s_2^2/n_2		
009	RCL2	36 02		065	RCL1	36 01			
010	-	-45		066	1	01			
011	RCL4	36 04		067	-	-45			
012	-	-45		068	÷	-24			
013	RCL1	36 01		069	RCL1	36 01			
014	1	01		070	÷	-24			
015	+	-55	Store s_2^2/n_2	071	STO8	35 08	Compute θ		
016	÷	-24		072	RCL6	36 06			
017	ENT↑	-21		073	+	-55			
018	ENT↑	-21		074	JX	54			
019	RCL4	36 04		075	÷	-24			
020	+	-55		076	RTN	24			
021	ENT↑	-21		077	*LBLA	21 15		Delete erroneous data	
022	ENT↑	-21	078	RCL6	36 06				
023	RCL2	36 02	079	RCL8	36 08				
024	+	-55	080	÷	-24				
025	STO2	35 02	081	JX	54				
026	LSTX	16-63	082	TAN↑	16 43				
027	-	-45	083	RTN	24				
028	-	-45	Store \bar{x}	084	*LBLA	21 16 12	Delete erroneous data		
029	STO4	35 04		085	RCL1	36 01			
030	R↓	-31		086	CHS	-22			
031	x	-35		087	STO1	35 01			
032	RCL1	36 01		088	R↓	-31			
033	x	-35		089	GTOA	22 11			
034	1	01		090					
035	LSTX	16-63							
036	+	-55							
037	ABS	16 31							
038	STO1	35 01							
039	x	-35							
040	ST+3	35-55 03							
041	RCL1	36 01							
042	RTN	24							
043	*LBLB	21 12	Store \bar{x}	100					
044	RCL2	36 02							
045	STO5	35 05							
046	RCL3	36 03							
047	RCL1	36 01							
048	1	01							
049	-	-45							
050	÷	-24							
051	RCL1	36 01	Store s_1^2/n_1						
052	÷	-24							
053	STO6	35 06							
054	RTN	24							
055	*LBLC	21 13							
056	STO7	35 07							
REGISTERS									
0	1	2	3	4	5	6	7	8	9
	n	running mean	sum of squares	Used	\bar{x}	s_1^2/n_1	D	s_2^2/n_2	
S0	S1	S2	S3	S4	S5	S6	S7	S8	S9
A	B	C	D	E	I				

SET STATUS

FLAGS

	ON	OFF
0	<input type="checkbox"/>	<input checked="" type="checkbox"/>
1	<input type="checkbox"/>	<input checked="" type="checkbox"/>
2	<input type="checkbox"/>	<input checked="" type="checkbox"/>
3	<input type="checkbox"/>	<input checked="" type="checkbox"/>

TRIG

DEG	<input checked="" type="checkbox"/>
GRAD	<input type="checkbox"/>
RAD	<input type="checkbox"/>

DISP

FIX	<input checked="" type="checkbox"/>
SCI	<input type="checkbox"/>
ENG	<input type="checkbox"/>
n_{2}	

Program Description I

Program Title **KRUSKAL-WALLIS STATISTIC**

Contributor's Name **Hewlett-Packard**

Address **1000 N.E. Circle Blvd.**

City **Corvallis**

State **Oregon**

Zip Code **97330**

Program Description, Equations, Variables

Suppose we want to test the null hypothesis that k independent random samples of sizes n_1, n_2, \dots, n_k come from identical continuous populations.

Arrange all values from k samples jointly (as if they were one sample) in an increasing order of magnitude. Let R_{ij} ($i = 1, 2, \dots, k, j = 1, 2, \dots, n_i$) be the rank of the j^{th} value in the i^{th} sample.

The Kruskal-Wallis statistic H can be used to test the null hypothesis.

When all sample sizes are large (> 5), H is distributed approximately as the chi-square with $k - 1$ degrees of freedom. For small samples, the test is based on special tables.

Equation:

$$H = \frac{12}{N(N+1)} \sum_{i=1}^k \frac{\left(\sum_{j=1}^{n_i} R_{ij} \right)^2}{n_i} - 3(N+1)$$

where

$$N = \sum_{i=1}^k n_i$$

Operating Limits and Warnings

This program has been verified only with respect to the numerical example given in *Program Description II*. User accepts and uses this program material AT HIS OWN RISK, in reliance solely upon his own inspection of the program material and without reliance upon any representation or description concerning the program material.

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Program Description I

Program Title	KRUSKAL-WALLIS STATISTIC		
Contributor's Name	Hewlett-Packard		
Address	1000 N.E. Circle Blvd.		
City	Corvallis	State	Oregon
		Zip Code	97330

Program Description, Equations, Variables	
<p>Table for small samples ($k = 3$):</p> <p>Alexander and Quade, <i>On the Kruskal-Wallis Three Sample H-statistic</i>, University of North Carolina, Department of Biostatistics, Inst. Statistics Mimeo Ser. 602, 1968.</p>	
<p>Operating Limits and Warnings</p>	

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Program Description II

Sketch(es)

Sample Problem(s)

Example:

i \ j	1	2	3	4	5	6	7	8	9	10
1	29	5	26	10	33	30				
2	11	12	9	7	20	18	19	21		
3	14	28	8	25	17	15	32	4	2	
4	6	27	3	16	24	13	1	31	22	23

Keystrokes:

A 29 B 5 B ... 30 B

C

11 B 12 B ... 21 B C

14 B 28 B ... 2 B C

6 B 27 B ... 23 B C

D

E

6.00

1.00

2.00

3.00

4.00

2.29 (H)

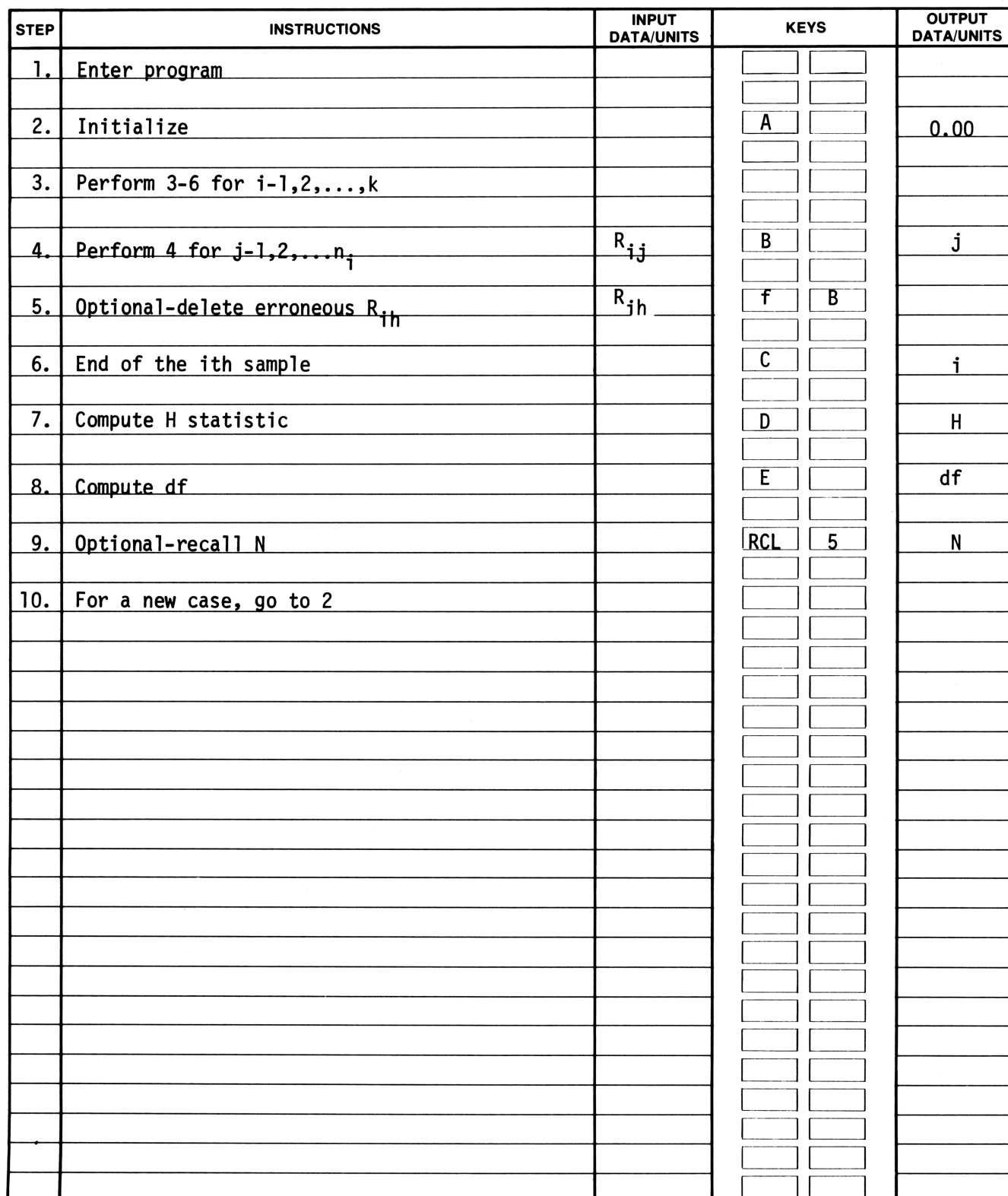
3.00 (df)

Solution(s)

Reference(s)

1. W.J. Conover, Practical Nonparametric Statistics, John Wiley and Sons, 1971.

2. This program is a translation of the HP-65 Stat Pac 2 program.



User Instructions

21

•KRUSKAL-WALLIS STATISTIC

INIT $R_{ij} \triangleright j$ $\triangleright i$ $\triangleright H$ $\triangleright df$

STEP	INSTRUCTIONS	INPUT DATA/UNITS	KEYS	OUTPUT DATA/UNITS
1	Enter program		<input type="text"/> <input type="text"/>	
2	Initialize		<input type="text"/> A <input type="text"/>	0.00
3	Perform 3-6 for $i = 1, 2, \dots, k$		<input type="text"/> <input type="text"/>	
4	Perform 4 for $j = 1, 2, \dots, n_i$	R_{ij}	<input type="text"/> B <input type="text"/>	j
5	Optional—delete erroneous R_{ih}	R_{ih}	<input type="text"/> GTO <input type="text"/> 1	
			<input type="text"/> R/S <input type="text"/>	
6	End of the i th sample		<input type="text"/> C <input type="text"/>	i
7	Compute H statistic		<input type="text"/> D <input type="text"/>	H
8	Compute df		<input type="text"/> E <input type="text"/>	df
9	Optional—recall N		<input type="text"/> RCL <input type="text"/> 5	N
10	For a new case, go to 2		<input type="text"/> <input type="text"/>	

97 Program Listing I

STEP	KEY ENTRY	KEY CODE	COMMENTS	STEP	KEY ENTRY	KEY CODE	COMMENTS
001	*LBLA	21 11	Initialize				
002	CLRG	16-53					
003	0	00		060			
004	RTN	24					
005	*LBLB	21 12	Accumulate sums				
006	ST+2	35-55 02					
007	RCL1	36 01					
008	1	01					
009	+	-55					
010	ST01	35 01	Prepare for a new sample				
011	RTN	24					
012	*LBLC	21 13		070			
013	RCL1	36 01					
014	ST+5	35-55 05					
015	RCL2	36 02	$(\sum R_{ij})^2$				
016	X ²	53					
017	X*Y	-41					
018	=	-24					
019	ST+3	35-55 03					
020	RCL4	36 04	Reinitialize registers R_1, R_2				
021	1	01		080			
022	+	-55					
023	ST04	35 04					
024	0	00					
025	ST01	35 01	Display sample number				
026	ST02	35 02					
027	RCL4	36 04					
028	RTN	24					
029	*LBLD	21 14					
030	RCL3	36 03	Compute H				
031	4	04					
032	x	-35					
033	RCL5	36 05		090			
034	=	-24					
035	RCL5	36 05	N + 1				
036	1	01					
037	+	-55					
038	=	-24					
039	LSTX	16-63					
040	-	-45	Compute df				
041	3	03		100			
042	x	-35					
043	RTN	24					
044	*LBL E	21 15					
045	RCL4	36 04	Delete erroneous data				
046	1	01					
047	-	-45					
048	RTN	24					
049	*LBL F	21 16 12					
050	ST-2	35-45 02					
051	RCL1	36 01					
052	1	01					
053	-	-45		110			
054	ST01	35 01					
055	RTN	24					

SET STATUS

FLAGS

TRIG

DISP

	ON	OFF
0	<input type="checkbox"/>	<input checked="" type="checkbox"/>
1	<input type="checkbox"/>	<input checked="" type="checkbox"/>
2	<input type="checkbox"/>	<input checked="" type="checkbox"/>
3	<input type="checkbox"/>	<input checked="" type="checkbox"/>

DEG ☒
 GRAD ☐
 RAD ☐

FIX ☒
 SCI ☐
 ENG ☐
 n 2

REGISTERS

0	1 n_i	2 $\sum R_{ij}$	3 $\sum [(\sum R_{ij})^2]$	4 k	5 N	6	7	8	9
S0	S1	S2	n_i	S4	S5	S6	S7	S8	S9
A	B	C	D	E	I				

Program Description I

Program Title

MEAN-SQUARE SUCCESSIVE DIFFERENCE

Contributor's Name

Hewlett-Packard

Address

1000 N.E. Circle Blvd.

City

Corvallis

State

Oregon

Zip Code

97330

Program Description, Equations, Variables

When test and estimation techniques are used, the method of drawing the sample from the population is specified to be random in most cases. If observations are chosen in sequence x_1, x_2, \dots, x_n , the mean-square successive difference η can be used to test for randomness.

If the sample size n is large (say, greater than 20) and the population is normal, then a z statistic has approximately the standard normal distribution. Long trends are associated with large positive values of z and short oscillations with large negative values.

Equations:

$$\eta = \sum_{i=2}^n (x_i - x_{i-1})^2 \bigg/ \sum_{i=1}^n (x_i - \bar{x})^2$$

$$= \sum_{i=2}^n (x_i - x_{i-1})^2 \bigg/ \left[\sum_{i=1}^n x_i^2 - \frac{\left(\sum_{i=1}^n x_i \right)^2}{n} \right]$$

$$z = \frac{1 - \eta/2}{\sqrt{\frac{n-2}{n^2 - 1}}}$$

Operating Limits and Warnings

This program has been verified only with respect to the numerical example given in *Program Description II*. User accepts and uses this program material AT HIS OWN RISK, in reliance solely upon his own inspection of the program material and without reliance upon any representation or description concerning the program material.

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Program Description II

Sketch(es)

Sample Problem(s)

Example:

Find the mean-square successive difference for the following set of data:

{0.53, 0.52, 0.39, 0.49, 0.97, 0.29, 0.65, 0.30, 0.40, 0.06, 0.14, 0.16, 0.68, 0.22, 0.68, 0.08, 0.52, 0.50, 0.63, 0.20, 0.67, 0.44, 0.64, 0.40, 0.97, 0.03, 0.73, 0.24, 0.57, 0.35}

Keystrokes:

A .53 B	→	1.00
.52 C .39 C35 C	→	30.00
D	→	2.81 (η)
E	→	-2.29 (z)

Solution(s)

Reference(s) 1. This program is a translation of the HP-65 Stat Pac 2 program.
 2. Dixon and Massey, Introduction to Statistical Analysis, McGraw-Hill, 1969.

User Instructions

MEAN-SQUARE
SUCCESSIVE DIFFERENCE

INIT x_1 $x_i \triangleright i$ $\triangleright \eta$ $\triangleright z$

STEP	INSTRUCTIONS	INPUT DATA/UNITS	KEYS	OUTPUT DATA/UNITS
1	Enter program		<div></div> <div></div>	
2	Initialize		<div>A</div> <div></div>	0.00
3	Input x_1	x_1	<div>B</div> <div></div>	1.00
4	Perform 4 for $i = 2, 3, \dots, n$	x_i	<div>C</div> <div></div>	i
5	Compute η		<div>D</div> <div></div>	η
6	Compute z		<div>E</div> <div></div>	z
7	For a new case, go to 2		<div></div> <div></div>	

STEP	KEY ENTRY	KEY CODE	COMMENTS	STEP	KEY ENTRY	KEY CODE	COMMENTS		
001	*LBLA	21 11	Initialize						
002	CLRG	16-53							
003	0	00							
004	RTN	24		060					
005	*LBLB	21 12							
006	STO5	35 05		Store x_1 and accumulate sums x_1^2					
007	ST+2	35-55 02							
008	ENT↑	-21							
009	X	-35							
010	ST+3	35-55 03							
011	RCL1	36 01							
012	1	01							
013	+	-55							
014	STO1	35 01	070						
015	RTN	24							
016	*LBLC	21 13	Store x_i						
017	RCL5	36 05							
018	XZY	-41							
019	STO5	35 05							
020	-	-45		$x_i - x_{i-1}$					
021	ENT↑	-21							
022	X	-35							
023	ST+4	35-55 04							
024	RCL5	36 05			080				
025	GTOB	22 12							
026	*LBLD	21 14							
027	RCL4	36 04							
028	RCL3	36 03							
029	RCL2	36 02							
030	ENT↑	-21	$(\sum x_i)^2$						
031	X	-35							
032	RCL1	36 01							
033	÷	-24							
034	-	-45		090					
035	÷	-24							
036	STO5	35 05		n					
037	RTN	24							
038	*LBLE	21 15			Compute z				
039	1	01							
040	RCL5	36 05							
041	2	02							
042	÷	-24							
043	-	-45							
044	RCL1	36 01							
045	2	02							
046	-	-45							
047	RCL1	36 01							
048	ENT↑	-21	z						
049	X	-35							
050	1	01							
051	-	-45							
052	÷	-24							
053	√X	54							
054	÷	-24							
055	RTN	24							

LABELS									
A	INT	B	x_1	C	x_i	D	n	E	z
a		b		c		d		e	
0		1		2		3		4	
5		6		7		8		9	

	FLAGS		SET STATUS					
			FLAGS		TRIG	DISP		
			ON	OFF				
0					DEG	<input checked="" type="checkbox"/>	FIX	<input checked="" type="checkbox"/>
1					GRAD	<input checked="" type="checkbox"/>	SCI	<input type="checkbox"/>
2					RAD	<input type="checkbox"/>	ENG	<input type="checkbox"/>
3							n	2

REGISTERS									
0	1	2	3	4	5	6	7	8	9
	n	$\sum x_i$	$\sum x_i^2$	$\sum (x_i - x_{i-1})^2$	$x_{i,n}$				
S0	S1	S2	S3	S4	S5	S6	S7	S8	S9
A	B	C	D	E	I				

Program Description I

Program Title	THE RUN TEST FOR RANDOMNESS		
Contributor's Name	Hewlett-Packard		
Address	1000 N.E. Circle Blvd.		
City	Corvallis	State	Oregon
		Zip Code	97330

<p>Program Description, Equations, Variables</p> <p>Consider a sequence of symbols such that the symbols are of two types only. A run is a continuous string of identical symbols preceded and followed by a different symbol or no symbol at all. For example, the sequence 1110100011 has five runs.</p> <p>Let the total number of runs in a given sequence be u, and let n_1 and n_2 represent the number of symbols of type 1 and type 2 respectively. If the sample sizes are large (say, n_1 and n_2 are both greater than 10), then the randomness of the sequence may be tested using a z statistic which has the standard normal distribution.</p> <p>Equations:</p> <p>The sample distribution of the run has the mean μ and the standard deviation σ.</p> $\mu = \frac{2 n_1 n_2}{n_1 + n_2} + 1$ $\sigma = \sqrt{\frac{2 n_1 n_2 (2 n_1 n_2 - n_1 - n_2)}{(n_1 + n_2)^2 (n_1 + n_2 - 1)}}$ <p>The test is based on the statistic</p> $z = \frac{u - \mu}{\sigma}$ <p>Operating Limits and Warnings</p>

This program has been verified only with respect to the numerical example given in *Program Description II*. User accepts and uses this program material AT HIS OWN RISK, in reliance solely upon his own inspection of the program material and without reliance upon any representation or description concerning the program material.

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Program Description I

Program Title	THE RUN TEST FOR RANDOMNESS		
Contributor's Name	Hewlett-Packard		
Address	1000 N.E. Circle Blvd.		
City	Corvallis	State	Oregon
		Zip Code	97330

Program Description, Equations, Variables	
<p>Remarks:</p> <ol style="list-style-type: none"> For small samples, the test is based on special tables. This program can also be used for other tests involving runs. For example, one might want to test runs of scores above and below the median based on the order in which the scores were obtained. In this case, a sequence could be constructed in which each score would be replaced by a 1 if it was above the median or a 0, if below the median. The run test for randomness can then be applied to the sequence of 0's and 1's. <p>Another use might be for Wald-Wolfowitz run test, which tests the null hypothesis that two random samples have been drawn from identical populations. The data from both groups are combined into one sequence according to magnitude. Each value may be assigned a 0 or 1 depending on which population it came from, and the run test for randomness then performed on the resulting sequence.</p>	
Operating Limits and Warnings	

This program has been verified only with respect to the numerical example given in *Program Description II*. User accepts and uses this program material AT HIS OWN RISK, in reliance solely upon his own inspection of the program material and without reliance upon any representation or description concerning the program material.

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Sketch(es)

Sample Problem(s)
<p>Example:</p> <p>A statistician sits by the roulette table one night in a Las Vegas casino, suspiciously watching the house rake in stake upon stake. To test the null hypothesis that the sequence of numbers is random, the statistician observes the following sequence of red (R) and black (B) numbers (ignoring 0 and 00):</p> <p style="text-align: center;">RRRR B RRR BBBB RR BBB RR BB RRR</p> <p>In the sequence are 14 R's, 11B's, and a total of 9 runs. Find the mean and standard deviation of the sampling distribution and the z statistic.</p> <p>Keystrokes:</p> <div style="margin-left: 20px;"> 14 [$\frac{1}{\square}$] 11 [A] 9 [B] [C] → 13.32 (μ) </div> <div style="margin-left: 20px;"> [D] → 2.41 (σ) </div> <div style="margin-left: 20px;"> [E] → -1.79 (z) </div> <p>(His suspicion is not entirely unjustified.)</p>
<p>Solution(s)</p>

(His suspicion is not entirely unjustified.)

Solution(s)

Reference(s) 1. Freund and Williams, Dictionary/Outline of Basic Statistics, McGraw-Hill, 1966.

2. This program is a translation of the HP-65 Stat Pac 2 program.

2. This program is a translation of the HP-65 Stat Pac 2 program.

User Instructions



THE RUN TEST FOR RANDOMNESS

$n_1 \uparrow n_2$

u

$\triangleright \mu$

$\triangleright \sigma$

$\triangleright z$

STEP	INSTRUCTIONS	INPUT DATA/UNITS	KEYS	OUTPUT DATA/UNITS
1	Enter program		<div></div> <div></div>	
2	Input		<div></div> <div></div>	
	number of symbols of type 1	n_1	<div>\uparrow</div> <div></div>	
	number of symbols of type 2	n_2	<div>A</div> <div></div>	n_1
3	Input number of runs	u	<div>B</div> <div></div>	u
4	Compute the mean		<div>C</div> <div></div>	μ
5	Compute the standard de-		<div></div> <div></div>	
	viation		<div>D</div> <div></div>	σ
6	Compute the z statistic		<div>E</div> <div></div>	z
7	For a new case, go to 2		<div></div> <div></div>	

97 Program Listing I

31

STEP	KEY ENTRY	KEY CODE	COMMENTS	STEP	KEY ENTRY	KEY CODE	COMMENTS
001	*LBLA	21 11					
002	ST02	35 02					
003	RJ	-31	Store n_2				
004	ST01	35 01	Store n_1	060			
005	RTN	24					
006	*LBLB	21 12					
007	ST03	35 03	Store u				
008	RTN	24					
009	*LBLC	21 13					
010	RCL1	36 01	Compute the mean				
011	RCL2	36 02					
012	X	-35					
013	2	02					
014	X	-35		070			
015	ST07	35 07					
016	RCL1	36 01					
017	RCL2	36 02					
018	+	-55					
019	ST08	35 08					
020	=	-24					
021	1	01					
022	+	-55					
023	ST04	35 04					
024	RTN	24		080			
025	*LBLD	21 14					
026	RCL7	36 07	Compute the				
027	RCL8	36 08	standard deviation				
028	-	-45					
029	RCL7	36 07					
030	X	-35	$(n_1+n_2)^2$				
031	RCL8	36 08					
032	ENT↑	-21					
033	X	-35					
034	RCL8	36 08		090			
035	1	01	n_1+n_2-1				
036	-	-45					
037	X	-35					
038	=	-24					
039	JX	54					
040	ST05	35 05					
041	RTN	24					
042	*LBL E	21 15	Compute the z				
043	RCL3	36 03	statistic	100			
044	RCL4	36 04					
045	-	-45					
046	RCL5	36 05					
047	=	-24					
048	ST06	35 06					
049	RTN	24					

LABELS					SET STATUS			
A	B	C	D	E	0	1	2	3
n_1	n_2	u	μ	σ	z	n_1+n_2	n_1+n_2-1	
a	b	c	d	e				
0	1	2	3	4				
5	6	7	8	9				

REGISTERS									
0	1	2	3	4	5	6	7	8	9
n_1	n_2	u	μ	σ	z	n_1+n_2	n_1+n_2-1		
S0	S1	S2	S3	S4	S5	S6	S7	S8	S9
A	B	C	D	E	F	G	H	I	J

Program Description I

Program Title	INTRAClass CORRELATION COEFFICIENT		
Contributor's Name	Hewlett-Packard		
Address	1000 N.E. Circle Blvd.		
City	Corvallis	State	Oregon
		Zip Code	97330

Program Description, Equations, Variables

The intraclass correlation coefficient r_I measures the degree of association among individuals within classes or groups.

		Observations			
Groups	1	x_{11}	x_{12}	...	x_{1n}
	2	x_{21}	x_{22}	...	x_{2n}

	k	x_{k1}	x_{k2}	...	x_{kn}

The coefficient is most easily calculated using the analysis of variance techniques. r_I is the sample estimate of the population intraclass correlation coefficient ρ_I . If we can assume that the individuals within groups are random samples from normal populations with the same variance, then the hypothesis $\rho_I = 0$ can be tested using the F statistic.

Equations:

1. Sums
Group $T_i = \sum_{j=1}^n x_{ij} \quad i = 1, 2, \dots, k$

Operating Li

Total $T = \sum_{i=1}^k T_i$

2. Sums of squares
Mean

$$MSS = T^2 / k n$$

This program has been verified only with respect to the numerical example given in *Program Description II*. User accepts and uses this program material AT HIS OWN RISK, in reliance solely upon his own inspection of the program material and without reliance upon any representation or description concerning the program material.

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Program Description I

Program Title INTRAClass CORRELATION COEFFICIENT

Contributor's Name Hewlett-Packard

Address 1000 N.E. Circle Blvd.

City Corvallis

State Oregon

Zip Code 97330

Program Description, Equations, Variables

Among groups

$$ASS = \sum_{i=1}^k T_i^2/n - MSS$$

Within groups

$$WSS = \sum_{i=1}^k \sum_{j=1}^n x_{ij}^2 - MSS - ASS$$

3. Intraclass correlation coefficient

$$r_I = \left(\frac{ASS}{k-1} - \frac{WSS}{k(n-1)} \right) / \left(\frac{ASS}{k-1} + \frac{WSS}{k} \right)$$

4. F statistic

$$F = \frac{ASS}{k-1} / \frac{WSS}{k(n-1)}$$

with $df_1 = k - 1$ and $df_2 = k(n - 1)$ degrees of freedom.

Operating Limits and Warnings

This program has been verified only with respect to the numerical example given in *Program Description II*. User accepts and uses this program material AT HIS OWN RISK, in reliance solely upon his own inspection of the program material and without reliance upon any representation or description concerning the program material.

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User Instructions

•INTRACLASS
CORRELATION COEFFICIENT

x_{ij}

$\triangleright T_i$

$\triangleright r_1$

$\triangleright F$

$\triangleright df_1 \triangleright df_2$

STEP	INSTRUCTIONS	INPUT DATA/UNITS	KEYS	OUTPUT DATA/UNITS
1	Enter program		<div></div> <div></div>	
2	Initialize		<div>f</div> <div>REG</div>	
3	Perform 3-5 for $i = 1, 2, \dots, k$		<div></div> <div></div>	
4	Perform 4 for $j = 1, 2, \dots, n$	x_{ij}	<div>A</div> <div></div>	j
5	Compute the group mean		<div>B</div> <div></div>	T_i
6	Compute the coefficient		<div>C</div> <div></div>	r_1
7	Compute the F statistic		<div>D</div> <div></div>	F
8	Compute the degrees of freedom		<div>E</div> <div></div>	df_1
			<div>E</div> <div></div>	df_2
9	For a new case, go to 2		<div></div> <div></div>	

97 Program Listing I

STEP	KEY ENTRY	KEY CODE	COMMENTS	STEP	KEY ENTRY	KEY CODE	COMMENTS
001	*LBLA	21 11	x_{ij}	057	RCL8	36 08	Display r_1
002	ST+6	35-55 06		058	+	-55	
003	X ²	53		059	=	-24	
004	ST+5	35-55 05	Increase counter	060	RTN	24	Compute F
005	1	01		061	*LBLD	21 14	
006	RCL1	36 01		062	RCL7	36 07	
007	+	-55	Compute group sum	063	RCL8	36 08	Compute degrees of freedom
008	ST01	35 01		064	RCL1	36 01	
009	RTN	24		065	=	-24	
010	*LBLB	21 12	Reinitialize	066	=	-24	
011	RCL6	36 06		067	RTN	24	
012	ST08	35 08		068	*LBLB	21 15	
013	ST+3	35-55 03	Display sum	069	RCL2	36 02	
014	X ²	53		070	1	01	
015	ST+4	35-55 04	Compute coefficient	071	-	-45	
016	RCL1	36 01		072	R/S	51	
017	ST07	35 07		073	*LBLB	21 15	
018	0	00	ASS/k-1	074	RCL1	36 01	
019	ST01	35 01		075	RCL2	36 02	
020	ST06	35 06		076	X	-35	
021	1	01		077	RTN	24	
022	RCL2	36 02					
023	+	-55					
024	ST02	35 02					
025	RCL8	36 08					
026	RTN	24					
027	*LBLC	21 13					
028	RCL4	36 04					
029	RCL3	36 03					
030	X ²	53					
031	RCL2	36 02					
032	=	-24					
033	-	-45					
034	RCL7	36 07					
035	ST01	35 01					
036	=	-24					
037	RCL2	36 02					
038	1	01					
039	-	-45					
040	=	-24					
041	ST07	35 07					
042	RCL5	36 05					
043	RCL4	36 04					
044	RCL1	36 01					
045	=	-24					
046	-	-45					
047	RCL2	36 02					
048	=	-24					
049	ST08	35 08					
050	RCL1	36 01					
051	1	01					
052	-	-45					
053	ST01	35 01					
054	=	-24					
055	-	-45					
056	RCL7	36 07					

FLAGS		SET STATUS		
0		FLAGS	TRIG	DISP
100	1	ON OFF	DEG <input checked="" type="checkbox"/>	FIX <input checked="" type="checkbox"/>
	2	1 <input type="checkbox"/> 0 <input checked="" type="checkbox"/>	GRAD <input type="checkbox"/>	SCI <input type="checkbox"/>
	3	2 <input type="checkbox"/> 0 <input checked="" type="checkbox"/>	RAD <input type="checkbox"/>	ENG <input type="checkbox"/>
	4	3 <input type="checkbox"/> 0 <input checked="" type="checkbox"/>		n <u>2</u>

LABELS				
A $\Sigma +$	B T_i	C Y_1	D F	E df_1, df_2
a	b	c	d	e
0	1	2	3	4
5	6	7	8	9

REGISTERS									
0	1 n-1	2 k	3 ΣT_i	4 ΣT_i^2	5 Σx_{ij}^2	6 T_i	7 ASS/k-1	8 T_i WSS/k	9 0
S0	S1	S2	S3	S4	S5	S6	S7	S8	S9
A	B	C	D	E	I				

Program Description I

Program Title

FISHER'S EXACT TEST FOR A 2 x 2 CONTINGENCY TABLE

Contributor's Name

Hewlett-Packard

Address

1000 N.E. Circle Blvd.

City

Corvallis

State

Oregon

Zip Code

97330

Program Description, Equations, Variables

Fisher's exact probability test is used for analyzing a 2 x 2 contingency table when the two independent samples are small in size.

a	b
c	d

Suppose a, b, c, d are the frequencies and a is the smallest frequency, this program computes the following:

1. The exact probability p_0 of observing the given frequencies in a 2 x 2 table, when the marginal totals are regarded as fixed.
2. The exact probability p_i ($i = 1, 2, \dots, a$) of each more extreme table having the same marginal totals.
3. The sum S_i of the probabilities of the first $i + 1$ tables.
4. The sum S of the probabilities of all tables with the same margins (i.e., $S = S_a$).

Equations:

$$1. \quad p_0 = \frac{(a+b)! (c+d)! (a+c)! (b+d)!}{N! a! b! c! d!}$$

where

$$N = a + b + c + d.$$

Operating Limits and Warnings

This program has been verified only with respect to the numerical example given in *Program Description II*. User accepts and uses this program material AT HIS OWN RISK, in reliance solely upon his own inspection of the program material and without reliance upon any representation or description concerning the program material.

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Program Description I

Program Title	FISHER'S EXACT TEST FOR A 2 x 2 CONTINGENCY TABLE		
Contributor's Name	Hewlett-Packard		
Address	1000 N.E. Circle Blvd.		
City	Corvallis	State	Oregon
		Zip Code	97330

Program Description, Equations, Variables					
2. For the more extreme table (with the same margins)					
<table><tr><td>a - i</td><td>b + i</td></tr><tr><td>c + i</td><td>d - i</td></tr></table>		a - i	b + i	c + i	d - i
a - i	b + i				
c + i	d - i				
$p_i = \frac{(a + b)! (c + d)! (a + c)! (b + d)!}{N! (a - i)! (b + i)! (c + i)! (d - i)!}$					
where	i can be 1, 2, ... or a.				
3.					
$S_n = \sum_{i=0}^n p_i$					
where	n can be 1, 2, ..., a.				
4.					
$S = \sum_{i=0}^a p_i$					
Operating Limits and Warnings					
Remarks:					
1.	a must be the smallest among the frequencies. Rearrange the table if necessary.				
2.	This program requires $N \leq 69$. However, Fisher's exact test is normally used for $N \leq 30$.				

<p>This program has been verified only with respect to the numerical example given in <i>Program Description II</i>. User accepts and uses this program material AT HIS OWN RISK, in reliance solely upon his own inspection of the program material and without reliance upon any representation or description concerning the program material.</p> <p>NEITHER HP NOR THE CONTRIBUTOR MAKES ANY EXPRESS OR IMPLIED WARRANTY OF ANY KIND WITH REGARD TO THIS PROGRAM MATERIAL, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. NEITHER HP NOR THE CONTRIBUTOR SHALL BE LIABLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES IN CONNECTION WITH OR ARISING OUT OF THE FURNISHING, USE OR PERFORMANCE OF THIS PROGRAM MATERIAL.</p>

A large grid of graph paper with 20 columns and 10 rows. The grid is composed of small squares, with a slightly larger square at the top left corner, likely for a title or header. The grid is empty, with no lines or text drawn on it.

This program is a translation of the HP-65 Stat Pac 2 program.

User Instructions

FISHER'S EXACT TEST FOR A
2 × 2 CONTINGENCY TABLE

a↕b↑
c↕d↗p₀

↗p_i

↗S_i

↗S

STEP	INSTRUCTIONS	INPUT DATA/UNITS	KEYS	OUTPUT DATA/UNITS
1	Enter program		<div></div> <div></div>	
2	Enter frequencies and compute		<div></div> <div></div>	
	p ₀	a	<div>↑</div> <div></div>	
		b	<div>↑</div> <div></div>	
		c	<div>↑</div> <div></div>	
		d	<div>A</div> <div></div>	p ₀
3*	Optional—perform 3 or 3-4 for		<div></div> <div></div>	
	i = 1, 2,..., a		<div>B</div> <div></div>	p _i
4	Optional—recall current S _i		<div>C</div> <div></div>	S _i
5	Compute the sum of all		<div></div> <div></div>	
	probabilities		<div>D</div> <div></div>	S
6	For a new case, go to 2		<div></div> <div></div>	
			<div></div> <div></div>	
	* It is not necessary to com-		<div></div> <div></div>	
	plete the loop of 3 and 4. Go to		<div></div> <div></div>	
	5 for S when desired.		<div></div> <div></div>	

97 Program Listing I

41

STEP	KEY ENTRY	KEY CODE	COMMENTS	STEP	KEY ENTRY	KEY CODE	COMMENTS
001	*LBLA	21 11		057	ST+3	35-55 03	
002	ST04	35 04		058	ST-4	35-45 04	
003	R↓	-31	Stored, c,b,a	059	ST-8	35-45 08	
004	ST03	35 03		060	RCL7	36 07	
005	R↓	-31		061	GT00	22 00	
006	ST02	35 02		062	*LBLC	21 13	Recall the sum S_n
007	X≠Y	-41		063	RCL5	36 05	
008	ST01	35 01		064	R/S	51	
009	ST08	35 08		065	*LBLD	21 14	Compute the sum S
010	+	-55		066	RCL8	36 08	
011	ST05	35 05		067	0	00	
012	R↓	-31		068	X=Y?	16-33	
013	+	-55		069	GSB1	23 01	
014	ST06	35 06		070	GSBB	23 12	
015	N!	16 52	(c+d)!	071	GT00	22 14	
016	RCL5	36 05		072	*LBL1	21 01	
017	N!	16 52	(a+b)!	073	RCL5	36 05	
018	X	-35		074	R/S	51	
019	RCL5	36 05		075	RTN	24	
020	RCL6	36 06					
021	+	-55					
022	N!	16 52					
023	÷	-24					
024	RCL1	36 01		080			
025	RCL3	36 03					
026	+	-55	(a+c)!				
027	N!	16 52					
028	X	-35					
029	RCL2	36 02					
030	RCL4	36 04					
031	+	-55					
032	N!	16 52	(b+d)!				
033	X	-35					
034	ST07	35 07		090			
035	0	00					
036	ST05	35 05					
037	R↓	-31					
038	*LBL0	21 00					
039	RCL1	36 01					
040	N!	16 52	Loop for computing probability				
041	÷	-24					
042	RCL2	36 02					
043	N!	16 52					
044	÷	-24		100			
045	RCL3	36 03					
046	N!	16 52					
047	÷	-24					
048	RCL4	36 04					
049	N!	16 52					
050	÷	-24	Accumulate the sum				
051	ST+5	35-55 05	Display ρ_0				
052	RTN	24					
053	*LBLB	21 12	Compute ρ_i for more extreme tables				
054	1	01					
055	ST-1	35-45 01					
056	ST+2	35-55 02					

REGISTERS			
0	1	2	3
S0	S1	S2	S3
A	B	C	D

SET STATUS			
0	1	2	3
ON	OFF	TRIG	DISP
0	<input type="checkbox"/>	DEG	<input checked="" type="checkbox"/>
1	<input type="checkbox"/>	GRAD	<input type="checkbox"/>
2	<input type="checkbox"/>	RAD	<input type="checkbox"/>
3	<input type="checkbox"/>		

5	6	7	8	9
a+b Used	c+d	Used	Used	
S5	S6	S7	S8	S9
E	I			

Program Description I

Program Title	BARTLETT'S CHI-SQUARE STATISTIC		
Contributor's Name	Hewlett-Packard		
Address	1000 N.E. Circle Blvd.		
City	Corvallis	State	Oregon
		Zip Code	97330

Program Description, Equations, Variables, etc.

$$\chi^2 = \frac{f \ln s^2 - \sum_{i=1}^k f_i \ln s_i^2}{1 + \frac{1}{3(k-1)} \left[\left(\sum_{i=1}^k \frac{1}{f_i} \right) - \frac{1}{f} \right]}$$

where s_i^2 = sample variance of the i^{th} sample

f_i = degrees of freedom associated s_i^2

$i = 1, 2, \dots, k$

k = number of samples

$$s^2 = \frac{\sum_{i=1}^k f_i s_i^2}{f}$$

$$f = \sum_{i=1}^k f_i$$

This χ^2 has a chi-square distribution (approximately) with $k - 1$ degrees of freedom which can be used to test the null hypothesis that $s_1^2, s_2^2, \dots, s_k^2$ are all estimates of the same population variance σ^2 ; i.e. H_0 : Each of $s_1^2, s_2^2, \dots, s_k^2$ is an estimate of σ^2 .

Note: Erroneous data can be corrected by using the **D** key.

Operating Limits and Warnings

This program has been verified only with respect to the numerical example given in *Program Description II*. User accepts and uses this program material AT HIS OWN RISK, in reliance solely upon his own inspection of the program material and without reliance upon any representation or description concerning the program material.

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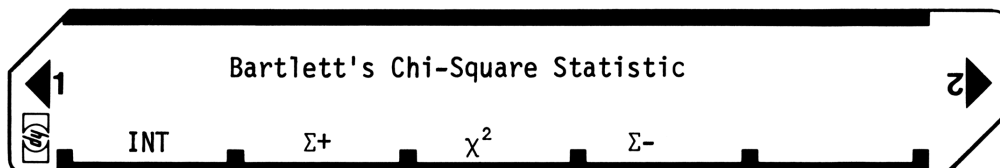
[illegible]

Sample Problem(s)		Apply the program to the following data:					
	i	1	2	3	4	5	6
	s_i^2	5.5	5.1	5.2	4.7	4.8	4.3
	f_i	10	20	17	18	8	15

Reference(s)

1. Statistical Theory with Engineering Applications, A. Hald, John Wiley and Sons, 1960.
2. This program is a translation of the HP-65 Stat Pac 1 program.

User Instructions

[illegible]

97 Program Listing I

45

STEP	KEY ENTRY	KEY CODE	COMMENTS	STEP	KEY ENTRY	KEY CODE	COMMENTS					
001	*LBLA	21 11	Initialize Clear storage registers Accumulate sums	057	R↓	-31						
002	CLRG	16-53		058	ENT↑	-21						
003	0	00		059	ENT↑	-21						
004	RTN	24		060	RCL1	36 01						
005	*LBLB	21 12		061	X	-35						
006	ST01	35 01		062	ST-8	35-45 08						
007	ST+3	35-55 03		063	X*Y	-41						
008	1/X	52		064	LN	32						
009	ST+4	35-55 04		065	RCL1	36 01						
010	R↓	-31		066	X	-35						
011	ENT↑	-21		067	ST-7	35-45 07						
012	ENT↑	-21		068	RCL5	36 05						
013	RCL1	36 01		069	1	01						
014	X	-35		070	-	-45						
015	ST+8	35-55 08		071	ST05	35 05						
016	X*Y	-41		072	RTN	24						
017	LN	32										
018	RCL1	36 01										
019	X	-35										
020	ST+7	35-55 07										
021	RCL5	36 05										
022	1	01										
023	+	-55										
024	ST05	35 05	080									
025	RTN	24										
026	*LBLC	21 13	Compute chi-square									
027	RCL8	36 08										
028	RCL3	36 03										
029	÷	-24										
030	LN	32										
031	RCL3	36 03										
032	X	-35										
033	RCL7	36 07										
034	-	-45		090								
035	RCL4	36 04										
036	RCL3	36 03										
037	1/X	52										
038	-	-45										
039	RCL5	36 05										
040	1	01										
041	-	-45										
042	ST02	35 02										
043	3	03										
044	X	-35		100								
045	÷	-24										
046	1	01										
047	+	-55										
048	÷	-24										
049	P/S	51		Display chi-square					SET STATUS			
050	RCL2	36 02								FLAGS	TRIG	DISP
051	RTN	24										
052	*LBLD	21 14								ON OFF		
053	ST01	35 01								0 <input type="checkbox"/> <input checked="" type="checkbox"/>	DEG <input checked="" type="checkbox"/>	FIX <input checked="" type="checkbox"/>
054	ST-3	35-45 03								1 <input type="checkbox"/> <input checked="" type="checkbox"/>	GRAD <input type="checkbox"/>	SCI <input type="checkbox"/>
055	1/X	52								2 <input type="checkbox"/> <input checked="" type="checkbox"/>	RAD <input type="checkbox"/>	ENG <input type="checkbox"/>
056	ST-4	35-45 04						3 <input type="checkbox"/> <input checked="" type="checkbox"/>			n <u>2</u>	
			Error corrector									
				110								
REGISTERS												
0	1 f_i	2 df	3 Σf_i	4 $\Sigma 1/f_i$	5 k	6 0	7 $\Sigma f_i \ln s_i^2$	8	9 0			
S0	S1	S2	S3	S4	S5	S6	S7	S8	S9			
A	B	C	D	E	I							

SET STATUS		
FLAGS	TRIG	DISP
ON OFF		
0 <input type="checkbox"/> <input checked="" type="checkbox"/>	DEG <input checked="" type="checkbox"/>	FIX <input checked="" type="checkbox"/>
1 <input type="checkbox"/> <input checked="" type="checkbox"/>	GRAD <input type="checkbox"/>	SCI <input type="checkbox"/>
2 <input type="checkbox"/> <input checked="" type="checkbox"/>	RAD <input type="checkbox"/>	ENG <input type="checkbox"/>
3 <input type="checkbox"/> <input checked="" type="checkbox"/>		n <u>2</u>

Program Description I

Program Title MANN-WHITNEY STATISTIC

Contributor's Name Hewlett-Packard

Address 1000 N.E. Circle Blvd.

City Corvalli

State Oregon

Zip Code 97330

Program Description, Equations, Variables, etc.

This program computes the Mann-Whitney test statistic on two independent samples of equal or unequal sizes. This test is designed for testing the null hypothesis of no difference between two populations.

Mann-Whitney test statistic is defined as

$$U = n_1 n_2 + \frac{n_1(n_1 + 1)}{2} - \sum_{i=1}^{n_1} R_i$$

where n_1 and n_2 are the sizes of the two samples. Arrange all values from both samples jointly (as if they were one sample) in an increasing order of magnitude, let R_i ($i = 1, 2, \dots, n_1$) be the ranks assigned to the values of the first sample (it is immaterial which sample is referred to as the "first").

When n_1 and n_2 are small, the Mann-Whitney test bases on the exact distribution of U and specially constructed tables. When n_1 and n_2 are both large (say, greater than 8) then

$$z = \frac{U - \frac{n_1 n_2}{2}}{\sqrt{n_1 n_2 (n_1 + n_2 + 1)/12}}$$

is approximately a random variable having the standard normal distribution.

Operating Limits and Warnings

For small samples (say, less than or equal to 8) the specially constructed tables should be used. For example:

Handbook of Statistical Tables, D. B. Owen, Addison-Wesley, 1962

This program has been verified only with respect to the numerical example given in *Program Description II*. User accepts and uses this program material AT HIS OWN RISK, in reliance solely upon his own inspection of the program material and without reliance upon any representation or description concerning the program material.

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Program Description II

Sketch(es)

Sample Problem(s)

Find U and Z for the following data:

Sample 1	14.9	11.3	13.2	16.6	17	14.1	15.4	13	16.9	
Rank R_i	7	1	4	12	14	5	10	3	13	
Sample 2	15.2	19.8	14.7	18.3	16.2	21.1	18.9	12.2	15.3	19.4
Rank	8	18	6	15	11	19	16	2	9	17

Note: 1. $n_1 = 9, n_2 = 10$

2. The ranks have already been assigned in the example.

Solution(s)

Keystrokes:

10[A] 7[B] 1[B] 4[B] -----

3[B] 13[B] -----> 9.00

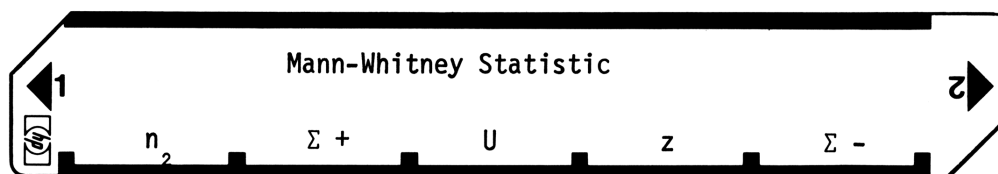
[C] -----> 66.00 (U)

[D] -----> 1.71 (Z)

Reference(s)

1. Mathematical Statistics, J.E. Freund, Prentic Hall, 1962.
2. This program is a translation of the HP-65 Stat Pac 1 program.

User Instructions

[illegible]

97 Program Listing I

49

STEP	KEY ENTRY	KEY CODE	COMMENTS	STEP	KEY ENTRY	KEY CODE	COMMENTS		
001	*LBLA	21 11	$n_2 \rightarrow R_2$ Store 0 in R_1, R_3						
002	ST02	35 02							
003	0	00							
004	ST01	35 01		060					
005	ST03	35 03							
006	RTN	24	Accumulate sums						
007	*LBLB	21 12							
008	ST+3	35-55 03							
009	RCL1	36 01							
010	1	01							
011	+	-55	Compute U						
012	ST01	35 01							
013	RTN	24		070					
014	*LBLC	21 13							
015	RCL2	36 02							
016	RCL1	36 01	Display U						
017	1	01							
018	+	-55							
019	2	02		080					
020	=	-24							
021	+	-55	Compute z						
022	x	-35							
023	RCL3	36 03							
024	-	-45							
025	RTN	24							
026	*LBLD	21 14							
027	RCL1	36 01							
028	RCL2	36 02							
029	x	-35							
030	2	02							
031	=	-24	Display z						
032	-	-45							
033	RCL1	36 01							
034	RCL2	36 02		090					
035	+	-55							
036	1	01	Error corrector						
037	+	-55							
038	RCL1	36 01							
039	x	-35							
040	RCL2	36 02							
041	x	-35							
042	1	01							
043	2	02							
044	=	-24		100					
045	IX	54							
046	=	-24							
047	RTN	24							
048	*LBLE	21 15							
049	ST-3	35-45 03							
050	RCL1	36 01							
051	1	01							
052	-	-45							
053	ST01	35 01		110					
054	RTN	24							
SET STATUS									
FLAGS				TRIG		DISP			
0	<input type="checkbox"/>	<input checked="" type="checkbox"/>		DEG	<input checked="" type="checkbox"/>	FIX	<input checked="" type="checkbox"/>		
1	<input type="checkbox"/>	<input checked="" type="checkbox"/>		GRAD	<input type="checkbox"/>	SCI	<input type="checkbox"/>		
2	<input type="checkbox"/>	<input checked="" type="checkbox"/>		RAD	<input type="checkbox"/>	ENG	<input type="checkbox"/>		
3	<input type="checkbox"/>	<input checked="" type="checkbox"/>				n	2		
REGISTERS									
0	1 n_1	2 n_2	3 ΣR_1	4	5	6	7	8	9
S0	S1	S2	S3	S4	S5	S6	S7	S8	S9
A	B	C	D	E	I				

Program Description I

Program Title KENDALL'S COEFFICIENT OF CONCORDANCE

Contributor's Name Hewlett-Packard

Address 1000 N.E. Circle Blvd.

City Corvallis **State** Oregon **Zip Code** 97330

Program Description, Equations, Variables, etc.

Suppose n individuals are ranked from 1 to n according to some specified characteristic by k observers, the coefficient of concordance W measures the agreement between observers (or concordance between rankings).

$$W = \frac{12 \sum_{i=1}^n \left(\sum_{j=1}^k R_{ij} \right)^2}{k^2 n(n^2 - 1)} - \frac{3(n+1)}{n-1}$$

Where R_{ij} is the rank assigned to the i^{th} individual by the j^{th} observer.

W varies from 0 (no community of preference) to 1 (perfect agreement). The null hypothesis that the observers have no community of preference may be tested using special tables, or if $n > 7$, by computing

$$\chi^2 = k(n-1)W$$

which has approximately the chi-square distribution with $n-1$ degrees of freedom (df).

Operating Limits and Warnings

For small samples (say, less than or equal to 7) the specially constructed tables should be used. For example:

Rank Correlation Methods, M.G. Kendall, Hafner Publishing Co., 1962

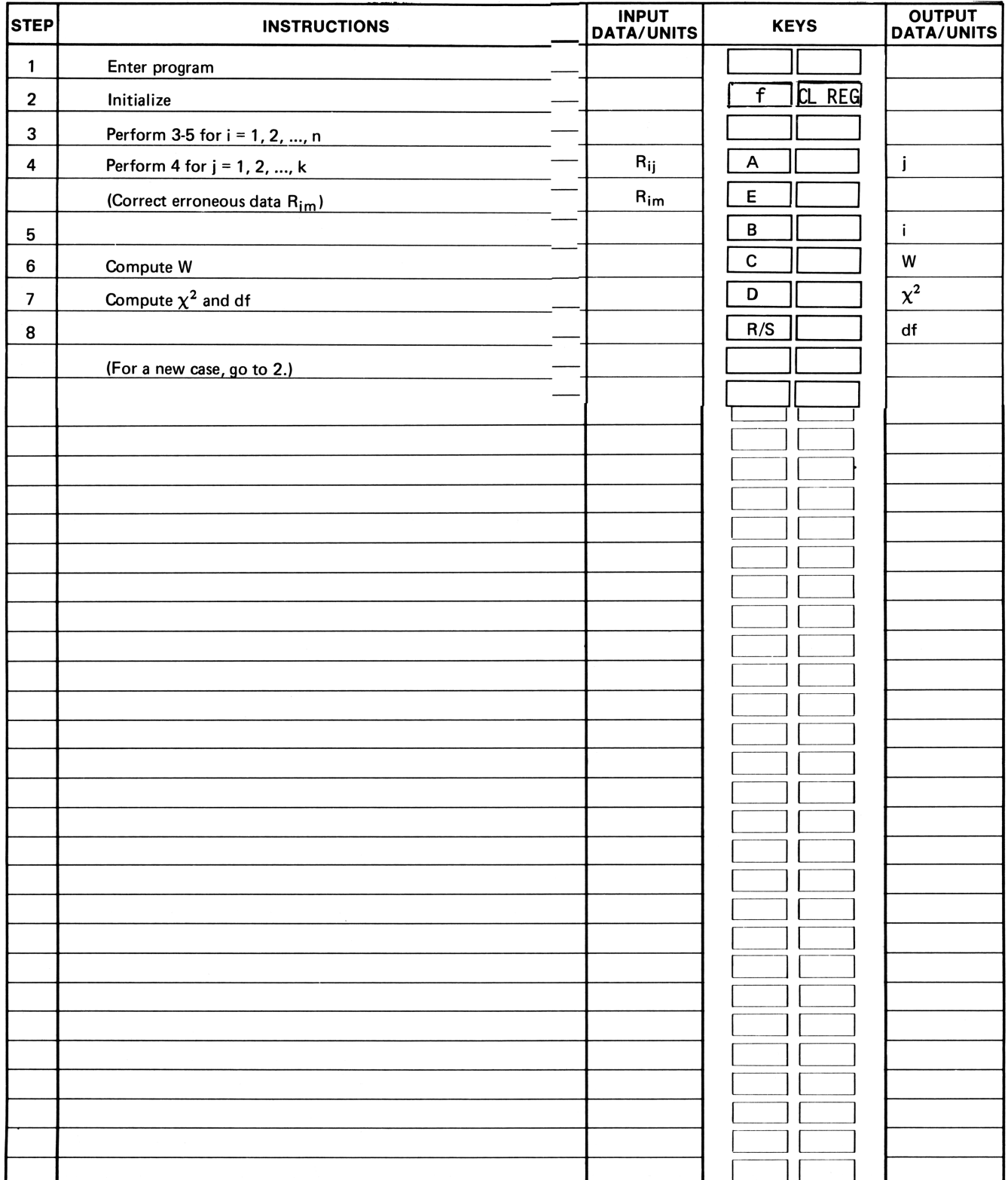
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[illegible][illegible]

1. The first part of the document is a title page. It contains the title of the document, the author's name, and the date of the document. The title is "The first part of the document is a title page. It contains the title of the document, the author's name, and the date of the document." The author's name is "The author's name is the name of the person who wrote the document." The date of the document is "The date of the document is the date when the document was written." The title page is the first page of the document and it is used to provide information about the document to the reader.

```
[f] [CL REG]
6[A] 7[A] 3[A] [B],
1[A] 4[A] 2[A] [B]
. . . .
7[A] 5[A] 7[A] [B]
[C] -----> 0.69 (W)
[D] -----> 18.64 ( $\chi^2$ )
[R/S] -----> 9.00 (df)
```



97 Program Listing I

53

STEP	KEY ENTRY ~	KEY CODE	COMMENTS	STEP	KEY ENTRY	KEY CODE	COMMENTS
001	*LBLA	21 11		057	RCL4	36 04	
002	ST+2	35-55 02		058	1	01	
003	RCL1	36 01	Accumulate sums (i is fixed)	059	-	-45	
004	1	01		060	RTN	24	
005	+	-55		061	*LBLE	21 15	Error corrector (i is fixed)
006	ST01	35 01	Display current j	062	ST-2	35-45 02	
007	RTN	24		063	RCL1	36 01	
008	*LBLB	21 12		064	1	01	
009	RCL1	36 01	Accumulate sum over i	065	-	-45	
010	ST05	35 05		066	ST01	35 01	
011	RCL2	36 02		067	RTN	24	
012	X²	53					
013	ST+3	35-55 03					
014	RCL4	36 04		070			
015	1	01					
016	+	-55					
017	ST04	35 04					
018	0	00					
019	ST01	35 01	Reinitialize R ₁ , R ₂				
020	ST02	35 02					
021	RCL4	36 04	Display current i				
022	RTN	24					
023	*LBLC	21 13					
024	RCL3	36 03	Compute W	080			
025	1	01					
026	2	02					
027	X	-35					
028	RCL5	36 05					
029	X²	53					
030	÷	-24					
031	RCL4	36 04					
032	÷	-24					
033	RCL4	36 04					
034	X²	53		090			
035	1	01					
036	-	-45					
037	÷	-24					
038	RCL4	36 04					
039	1	01					
040	+	-55					
041	3	03					
042	X	-35					
043	RCL4	36 04					
044	1	01		100			
045	-	-45					
046	÷	-24					
047	-	-45					
048	RTN	24	Display answer W				
049	*LBLD	21 14					
050	RCL5	36 05	Compute X² and df k				
051	X	-35					
052	RCL4	36 04					
053	1	01					
054	-	-45		110			
055	X	-35	Display X²				
056	R/S	51					

REGISTERS									
0	1 j ΣR_{ij}	2	3 $(\Sigma R_{ij})^2$	4 n	5 k	6	7	8	9
S0	S1	S2	S3	S4	S5	S6	S7	S8	S9
A	B	C	D	E	I				

SET STATUS		
FLAGS	TRIG	DISP
ON OFF		
0 <input type="checkbox"/> <input checked="" type="checkbox"/>	DEG <input checked="" type="checkbox"/>	FIX <input checked="" type="checkbox"/>
1 <input type="checkbox"/> <input checked="" type="checkbox"/>	GRAD <input type="checkbox"/>	SCI <input type="checkbox"/>
2 <input type="checkbox"/> <input checked="" type="checkbox"/>	RAD <input type="checkbox"/>	ENG <input type="checkbox"/>
3 <input type="checkbox"/> <input checked="" type="checkbox"/>		n <u>2</u>

NOTES

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Chemistry
Optics
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Earth Sciences
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Aviation
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TEST STATISTICS FOR THE CORRELATION COEFFICIENT

DIFFERENCES AMONG PROPORTIONS

BEHRENS-FISHER STATISTIC

KRUSKAL-WALLIS STATISTIC

MEAN-SQUARE SUCCESSIVE

THE RUN TEST FOR RANDOMNESS

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