STANDARD DEVIATION, "n" FORMULA

The keytop function for computing the standard deviation on the Micro-Statistician is based on the "n - 1" formula. When the "n" formulation is desired, this program may be used.

\[
SD_n = \sqrt{\frac{\sum x^2 - (\sum x)^2}{n}}
\]

Computer Design Corporation
12401 West Olympic Boulevard, Los Angeles, California 90064
STANDARD DEVIATION, "n" FORMULA

EXAMPLE: Calculate SD\(_n\) for 6, 3, 5, 4, 7 and 1.

1. ENTER GROUP

2. Enter \(X_1\), \(X_2\), ... Continue step 2 for all \(X_i\)

3. Load program from facing page

4. Read SD\(_n\) = 1.972

NEXT PROBLEM:

1. CLEAR GROUP

2. Enter \(X_1\), \(X_2\), ... Repeat step 2 for all \(X_i\)

3. START STOP, read SD\(_n\)
LEAST SQUARES FIT TO AN EXPONENTIAL CURVE

This program determines the Pearson correlation coefficient and the least squares fit for data in the form of an exponential curve where:

\[ Y = be^{mx} \]

Output from the program includes the coefficients necessary for calculating the equation of the line.
### EXAMPLE:

Obtain \( r \), \( m \) and \( b \) for:

<table>
<thead>
<tr>
<th>( X )</th>
<th>0.68</th>
<th>1.2</th>
<th>1.8</th>
<th>2.64</th>
</tr>
</thead>
<tbody>
<tr>
<td>( Y )</td>
<td>2.3</td>
<td>1.65</td>
<td>1.35</td>
<td>0.85</td>
</tr>
</tbody>
</table>

1. **GROUP**
   - **CLEAR GROUP**
   - **XY**

2. **RUN**
   - Load program from facing page, entering the first \( X \) and \( Y \) at steps 2 and 5, respectively

3. **START**
   - **STOP**

4. Enter next \( X \),
   - **START**

5. Enter next \( Y \),
   - **START**
   - **STOP**
   - Continue steps 4 and 5 for all \( X \), \( Y \) pairs

6. **LIN**
   - **NEG**
   - read Pearson \( r \) = -0.995

7. **2ND FUNC**
   - read \( m \) = -0.491

8. **0**
   - **LINE**
   - \( 10^5 \)
   - read \( b \) = 3.142

**NEXT PROBLEM:**

<table>
<thead>
<tr>
<th>( X )</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>( Y )</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. **GROUP**
   - **CLEAR GROUP**
   - **XY**

2. Enter an \( X \),
   - **START**

3. Enter a \( Y \),
   - **START**
   - **STOP**
   - Repeat steps 2 and 3 for all \( X \), \( Y \) pairs

4. **LIN**
   - **NEG**
   - read Pearson \( r \)

5. **2ND FUNC**
   - read \( m \)

6. **0**
   - **LINE**
   - \( 10^5 \)
   - read \( b \). Return to step 1 for next problem.
FACTORIAL OF $N$, $N!$

The following program evaluates the factorial of $N$, where:

$$N! = N(N - 1)(N - 2)(N - 3) \cdots 1,$$

and $1 \leq N \leq 69$

The limit of $N!$ where $N$ cannot exceed 69 is due to an overflow condition (the number exceeds $1 \times 10^{98}$).
### N FACTORIAL

**Example:** Compute $N!$ for $N = 5$.

1. **RUN**
   - Load program from facing page.
2. **LOAD**
   - Enter $N$.
3. When $E----$ appears in the display,
   - Reset and recall $2$, read $N! = 120$

**Next Problem:**

1. **LOAD**
   - Enter $N$.
2. When $E----$ appears in the display,
   - Reset and recall $2$, read $N!$.
STANDARD ERROR OF THE MEAN

This program calculates the standard error of the mean ($S_X$) where:

$$S_X = \frac{SD}{\sqrt{N}}$$

and where

$$SD = \sqrt{\frac{\sum X^2 - (\sum X)^2}{N}}$$

While this program is so brief that it can easily be executed on the keyboard, it is included as a program to demonstrate the ease of using the programming capacity of the 342 Statistician.

Computer Design Corporation
12401 West Olympic Boulevard, Los Angeles, California 90064
STANDARD ERROR OF THE MEAN

EXAMPLE: Compute $S_X$ for 19, 23, 41, 10, 15, 28, 14.

1. CLEAR GROUP SET DP 3

2. Enter $X_i$, REPE. Continue step 2 for all $X_i$.

3. LOAD Load program from facing page.

4. Read $S_X = 3.969$

NEXT PROBLEM:

1. CLEAR GROUP

2. Enter $X_i$, REPE. Repeat step for all $X_i$

3. START STOP, read $S_X$
The calculation of the geometric mean is based on the formula:

\[ M_G = \sqrt[n]{X_1 X_2 \cdots X_n} \]

NOTE: \( X_i = 0 \) will result in \( M_G = 0 \), and any negative \( X_i \) will lead to an error condition when the product under the radical results in a negative value.
EXAMPLE: To calculate \( M_G \) for the following data: 
\[(15, 12, 17, 10, 15, 9) \] \( n = 6 \)

1. Enter \( X_1 \) \( (15) \) 15.000
2. Enter \( X_1 \) \( 15.000 \)
3. Press \( \text{RESET} \) repeat steps 2 and 3 for all \( X_i \) except for the last one \( (X_n) \)
4. Enter \( X_n \) \( (9) \)
5. Press \( \text{RUN} \)
6. Load program from facing page.

Display now reads: 12.667

NEXT PROBLEM:

1. Enter \( X_1 \), repeat for all \( X_i \) except last one
2. Enter \( X_n \), \( \text{START} \)
3. Enter \( n \), \( \text{START} \)

The display now contains \( M_G \)

For next problem, return to step 1.
HARMONIC MEAN - \( H \)

The harmonic mean is the reciprocal of the arithmetic mean of the reciprocals of the data items.

\[
H = \frac{N}{\sum \frac{1}{x_i}}
\]

While this program is so brief that it can easily be executed on the keyboard, it is included as a program to demonstrate the ease of using the programming capacity of the 342 Statistician.

Computer Design Corporation
12401 West Olympic Boulevard, Los Angeles, California 90064
EXAMPLE:

To calculate the harmonic mean of 12, 15, 10 and 14.

1. Enter X₁ (12) 0.000
2. 12.000
3. \( \frac{1}{x} \) 0.083
4. Harmonic Mean is displayed 12.444

NEXT PROBLEM:

1. CLEAR GROUP 0.000
2. Enter X₁
3. \( \frac{1}{x} \) Repeat steps 2 and 3 for all X₁
4. \( \frac{1}{x} \) and the display contains the harmonic mean
LEAST SQUARES FIT TO A POWER CURVE

This program determines the Pearson correlation coefficient \( r \) and the least squares fit for data in the form of a power curve

where

\[ Y = bX^m \]

where

\( X \) and \( Y > 0.0 \)

Output from the program includes the coefficients necessary for calculating the equation of the line, \( m \) and \( b \).

Computer Design Corporation
12401 West Olympic Boulevard, Los Angeles, California 90064
### EXAMPLE

Obtain \( r, m \) and \( b \) for:

\[
\begin{array}{c|cccc}
X & 1 & 2.1 & 2.95 & 4.05 \\
Y & 3.1 & 4.26 & 5.22 & 6.05
\end{array}
\]

1. **GROUP**
   - **CLEAR GROUP**
   - **XY**
2. **RUN**
   - Load program from facing page, entering the first \( X \) and \( Y \) at steps 2 and 6, respectively.
3. **START**
4. **STOP**
5. **ENTER**
6. **START**
7. **STOP**
8. **RUN**
9. **LOAD**
10. **LOAD**
11. **LOAD**
12. **LOAD**
13. **LOAD**
14. **LOAD**
15. **LOAD**
16. **LOAD**
17. **LOAD**
18. **LOAD**
19. **LOAD**
20. **LOAD**

#### NEXT PROBLEM:

1. **GROUP**
   - **CLEAR GROUP**
   - **XY**
2. **ENTER**
3. **START**
4. **STOP**
5. **ENTER**
6. **START**
7. **STOP**
8. **START**
9. **STOP**
10. **START**
11. **STOP**
12. **START**
13. **STOP**
14. **START**
15. **STOP**
16. **START**
17. **STOP**
18. **START**
19. **STOP**
20. **START**

### Instructions

1. Enter next \( X \),
2. Enter next \( Y \),
3. Repeat steps 2 and 3 for all \( X, Y \) pairs.
4. Read Pearson \( r \) or \( r^2 \),
5. Read \( m \) or \( m^2 \),
6. Read \( b \). Return to step 1 for next problem.
LOGARITHMIC CURVE FITTING (Probit Analysis)

When the data points on a Cartesian plot resemble a better "fit" of the data can often be achieved by transforming the "X" values to their logarithmic equivalents.

\[ Y_{est} = mX_{\log_{10}} + b, \] and the Pearson correlation coefficient will be based on the transformed X values.

Computer Design Corporation
12401 West Olympic Boulevard, Los Angeles, California 90064
EXAMPLE: To calculate \( r, m \) and \( b \) on the following data, with \( X \) values changed to \( \log_{10} \):

\[
\begin{array}{c|c|c|c|c|c|c|c|c}
X & 1 & 5 & 10 & 15 & 20 & 25 \\
Y & 1 & 12 & 18 & 22 & 24 & 25 \\
\end{array}
\]

1. \[ \text{RESET} \quad \text{CLEAR} \quad \text{GROUP} \quad \text{STOP} \quad \text{RUN} \]

2. Load program from facing page, entering the first \( X \) and \( Y \) at steps 2 and 5 respectively.

3. \[ \text{START} \quad \text{STOP} \]

4. Enter \( X \), \[ \text{START} \quad \text{STOP} \]; enter \( Y \), \[ \text{START} \quad \text{STOP} \]. Continue step 4 for all \( X, Y \) pairs.

5. \[ \text{LIN \quad REG} \], read Pearson \( \hat{r} = 0.9978 \)

\[ \text{2ND \quad FUNC} \], read \( m = 17.6641 \); \[ \text{0 \quad LINE} \], read \( b = 0.5899 \).

NEXT PROBLEM:

1. \[ \text{CLEAR \quad GROUP} \quad \text{STOP} \]

2. Enter \( X \), \[ \text{START} \quad \text{STOP} \]; enter \( Y \), \[ \text{START} \quad \text{STOP} \]. Continue step 2 for all \( X, Y \) pairs. (Enter \( X \) when \( "1" \) is displayed; enter \( Y \) when \( "2" \) is displayed.)

3. \[ \text{LIN \quad REG} \], read \( \hat{r} \); \[ \text{2ND \quad FUNC} \], read \( m \); \[ \text{0 \quad LINE} \], read \( b \). Return to step 1 for new data.

NOTE 1: No \( X \) may be less than 1.

NOTE 2: Means of \( X_{\log} \) and of \( Y \) may be obtained after step 3 by using:

\[ \text{2ND \quad \text{Funct}} \] for \( X \) and \[ \text{2ND \quad \mean} \] for \( Y \) with \[ \text{SD \quad \text{Funct}} \].

To calculate line

\[ \text{Enter} \quad X \] \[ \text{Lin} \quad \text{2nd} \quad \text{Lin} \Rightarrow Y(\text{ax+b}) \]
The multiple correlation coefficient may be used to determine the relationship that two sets of numbers (the "independent" variables) have with another set (the "dependent" variable).

\[ R_{1,23} = \sqrt{ \frac{r_{12}^2 + r_{13}^2 - 2r_{12}r_{13}r_{23}}{1 - r_{23}} } \]

The program assumes that the 3 pairwise correlations \((r_{12}, r_{13}, r_{23})\) have already been computed.
COEFFICIENT OF MULTIPLE CORRELATION

EXAMPLE
Compute \( R_{1,23} \) when \( r_{12} = 0.48, r_{13} = 0.73, r_{23} = 0.37 \)

**RUN**

1. ☐ Load program from facing page, entering \( r_{12}, r_{13}, \) and \( r_{23} \) at
   steps 4, 9 and 14, respectively.
2. The display now reads \( R_{1,23} = 0.764 \)

NEXT PROBLEM

1. ☐ START STOP, display reads "1.0", enter \( r_{12} \)
2. ☐ START STOP, display reads "2.0", enter \( r_{13} \)
3. ☐ START STOP, display reads "3.0", enter \( r_{23} \)
4. ☐ START STOP, display reads answer - \( R_{1,23} \)

Return to step 1 for next problem.
To calculate \( R_{2,13} \) enter the pairwise correlations as follows:

First \( r_{12} \); Second \( r_{23} \); Third \( r_{13} \)

For \( r_{3,12} \) enter as follows:

First \( r_{13} \); Second \( r_{23} \); Third \( r_{12} \)
The partial correlation coefficient expresses the degree of relationship between 2 variables when the effect of a third variable is removed.

\[ r_{12.3} = \frac{r_{12} - r_{13}r_{23}}{\sqrt{1 - r_{13}^2}\sqrt{1 - r_{23}^2}} \]

Here, the effect of variable 3 is removed while determining the relationship of variables 1 and 2.

The program assumes that the 3 pairwise correlations \( (r_{12}, r_{13}, r_{23}) \) have already been computed.
COEFFICIENT OF PARTIAL CORRELATION

EXAMPLE

Compute \( r_{12.3} \) when \( r_{12} = 0.36 \), \( r_{13} = 0.41 \) and \( r_{23} = 0.14 \).

RUN

1. Load program from facing page, entering \( r_{12} \), \( r_{13} \) and \( r_{23} \) at steps 2, 6 and 11 respectively.
2. The display now reads \( r_{12.3} = 0.335 \)

NEXT PROBLEM

1. display reads "1.0", enter \( r_{12} \)
2. display reads "2.0", enter \( r_{13} \)
3. display reads "3.0", enter \( r_{23} \)
4. display reads answer \(-r_{12.3}\)

Return to step 1 for next problem.

To calculate \( r_{13.2} \), enter the pairwise correlations as follows:
- First \( r_{13} \); Second \( r_{12} \); Third \( r_{23} \).

To calculate \( r_{23.1} \):
- First \( r_{23} \); Second \( r_{12} \); Third \( r_{13} \).
Any root of a number can be obtained by:

\[ \Delta = \sqrt[n]{x} \]

which, for purposes of calculation, can be rewritten as:

\[ \Delta = x^{1/n} \]

**NOTE:**
- \( x \geq 0 \)
- \( n > 0 \)

While this program is so brief that it can easily be executed on the keyboard, it is included as a program to demonstrate the ease of using the programming capacity of the 342 Statistician.

**Computer Design Corporation**
12401 West Olympic Boulevard, Los Angeles, California 90064
### nth ROOT OF X

**NOTE:** This solution may at times appear to give erroneous results (i.e. the cube root of 125 will yield 4.999 rather than 5.000). This error is actually less than 0.0000000001.

**EXAMPLE:** Obtain the cube root of 27: $\sqrt[3]{27} = 27^{1/3}$

1. **RESET** SET UP 3
   **RUN**
   0.000
2. Load program from facing page.
   **LOAD**
   Display now contains $\Delta$ 3.000

**NEXT PROBLEM:**

1. **START** STOP
   1.000
2. Enter X
3. **START** STOP
   2.000
4. Enter n
5. **START** STOP, display contains $\Delta$.

Return to step 1 for next problem.

---

### Calculation Table

<table>
<thead>
<tr>
<th>Step</th>
<th>Action</th>
<th>X</th>
<th>Y</th>
<th>Z</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>LOAD</strong></td>
<td>21</td>
<td>41</td>
<td>91</td>
</tr>
<tr>
<td>2</td>
<td><strong>START</strong> STOP</td>
<td>22</td>
<td>42</td>
<td>82</td>
</tr>
<tr>
<td>3</td>
<td><strong>START</strong> STOP</td>
<td>23</td>
<td>43</td>
<td>83</td>
</tr>
<tr>
<td>4</td>
<td><strong>START</strong> STOP</td>
<td>24</td>
<td>44</td>
<td>84</td>
</tr>
<tr>
<td>5</td>
<td><strong>START</strong> STOP</td>
<td>25</td>
<td>45</td>
<td>85</td>
</tr>
<tr>
<td>6</td>
<td><strong>START</strong> STOP</td>
<td>28</td>
<td>46</td>
<td>86</td>
</tr>
<tr>
<td>7</td>
<td><strong>START</strong> STOP</td>
<td>27</td>
<td>47</td>
<td>87</td>
</tr>
<tr>
<td>8</td>
<td><strong>START</strong> STOP</td>
<td>28</td>
<td>48</td>
<td>88</td>
</tr>
<tr>
<td>9</td>
<td><strong>START</strong> STOP</td>
<td>29</td>
<td>49</td>
<td>89</td>
</tr>
<tr>
<td>10</td>
<td><strong>START</strong> STOP</td>
<td>30</td>
<td>50</td>
<td>90</td>
</tr>
<tr>
<td>11</td>
<td><strong>START</strong> STOP</td>
<td>31</td>
<td>51</td>
<td>91</td>
</tr>
<tr>
<td>12</td>
<td><strong>START</strong> STOP</td>
<td>32</td>
<td>52</td>
<td>92</td>
</tr>
<tr>
<td>13</td>
<td><strong>START</strong> STOP</td>
<td>33</td>
<td>53</td>
<td>93</td>
</tr>
<tr>
<td>14</td>
<td><strong>START</strong> STOP</td>
<td>34</td>
<td>54</td>
<td>94</td>
</tr>
<tr>
<td>15</td>
<td><strong>START</strong> STOP</td>
<td>35</td>
<td>55</td>
<td>95</td>
</tr>
<tr>
<td>16</td>
<td><strong>START</strong> STOP</td>
<td>36</td>
<td>56</td>
<td>96</td>
</tr>
<tr>
<td>17</td>
<td><strong>START</strong> STOP</td>
<td>37</td>
<td>57</td>
<td>97</td>
</tr>
<tr>
<td>18</td>
<td><strong>START</strong> STOP</td>
<td>38</td>
<td>58</td>
<td>98</td>
</tr>
<tr>
<td>19</td>
<td><strong>START</strong> STOP</td>
<td>38</td>
<td>59</td>
<td>99</td>
</tr>
<tr>
<td>20</td>
<td><strong>START</strong> STOP</td>
<td>40</td>
<td>60</td>
<td>00</td>
</tr>
</tbody>
</table>
ANALYSIS OF VARIANCE, ONE FACTOR

This program computes the F ratio describing the variance components in a one factor design.

The program permits any number of levels (groups) and any number of data items at any level (equal or unequal cell sizes).

The output data is complete, and includes the Mean and SD for each level and the complete ANOVA table.

Data for Example:

<table>
<thead>
<tr>
<th>DATA</th>
<th>SD</th>
<th>(\bar{x})</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1</td>
<td>3, 5, 2, 4, 8</td>
<td>2.302</td>
</tr>
<tr>
<td>Level 2</td>
<td>4, 4, 3, 2</td>
<td>0.957</td>
</tr>
<tr>
<td>Level 3</td>
<td>6, 7, 8, 6, 7, 9</td>
<td>1.169</td>
</tr>
</tbody>
</table>

See Statistics for Psychologists, Hays (1963) for the formulas used in this problem.

Computer Design Corporation
12401 West Olympic Boulevard, Los Angeles, California 90064
EXAMPLE: Compute $F$ for the example data.

1. **RUN**
   - 1
   - 2
   - 1
   - 1
   - LOAD
   - 1

   Load program from facing page through step 25.

2. **CLEAR GROUP**
   - 2
   - 1
   - **LOAD**
   - 8
   - 8
   - 8
   - 8
   - 8

   Enter number of levels (3), **LOAD**.

3. Enter X, **LOAD**, repeat step 3 for all X's in the level, then

4. **SD MEAN**, read SD, **2ND FUNC**, read Mean, **START STOP**

5. Repeat steps 3 and 4 for all 3 levels

6. Carry out steps 31-72. DO NOT LOAD THESE AS PROGRAM STEPS. Leave the program switch in the **RUN** position. Notice the output at steps 36, 44, 46, 58, 66, 68, and 72.

<table>
<thead>
<tr>
<th>SOURCE</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Within</td>
<td>30.783</td>
<td>12</td>
<td>2.565</td>
<td></td>
</tr>
<tr>
<td>Between</td>
<td>41.616</td>
<td>2</td>
<td>20.808</td>
<td>0.111</td>
</tr>
</tbody>
</table>

**LOAD**

**NEXT PROBLEM:**

1. **CLEAR GROUP**
   - 1
   - 1
   - **LOAD**

   Enter number of levels, **LOAD**.

2. Enter X, **LOAD**, repeat step 2 for all X's in the level, then

3. **SD MEAN**, read SD, **2ND FUNC**, read Mean, **START STOP**, repeat steps 2 and 3 for all levels.

4. Carry out steps 31-72. Leave program switch in **LOAD**. Record the output for the ANOVA table at steps 36, 44, 46, 58, 66, 68, and 72.

Return to step 1 for the next problem.
The point-biserial correlation is useful when the relationship between a dichotomous and a continuous variable is to be determined.

\[
\rho_b = \frac{\bar{Y}_1 - \bar{Y}_0}{S_Y} \sqrt{\frac{N_1N_0}{N(N-1)}}
\]

where:
- \( \bar{Y}_1 \) = mean of \( Y \)'s associated with 1
- \( \bar{Y}_0 \) = mean of \( Y \)'s associated with 0
- \( S_Y \) = standard deviation of all the \( Y \)'s
- \( N = N_1 + N_0 \) and

where:
- \( t = \frac{\rho_b \sqrt{N - 2}}{1 - \rho_b^2} \), \( df = N - 2 \)
EXAMPLE:  For the data

<table>
<thead>
<tr>
<th>X</th>
<th>1</th>
<th>1</th>
<th>1</th>
<th>1</th>
<th>0</th>
<th>0</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y</td>
<td>104</td>
<td>92</td>
<td>101</td>
<td>111</td>
<td>82</td>
<td>76</td>
<td>85</td>
</tr>
</tbody>
</table>

1. CLEAR GROUP

2. Enter a $Y_1$: $Y_1$, and continue for all $Y_1$

3. CLEAR GROUP

4. Enter a $Y_0$: $Y_0$, and continue for all $Y_0$

5. Load program from facing page

NOTE: Between steps 12 and 13, be sure to

For this data: $Y_0 = 84.5$, $Y_1 = 102$, $S_Y = 11.877$, $r_{pb} = 0.787$, $t = 3.13$ (The "t" calculation indicates the significance of $r_{pb}$.)

NEXT PROBLEM:

1. CLEAR GROUP

2. Enter a $Y_1$: $Y_1$, and continue for all $Y_1$

3. CLEAR GROUP

4. Enter a $Y_0$: $Y_0$, and continue for all $Y_0$

5. read $Y_0$ in display

6. read $Y_1$

7. read $S_Y$

8. read $r_{pb}$

9. read $t$, and return to step 1 for new data.
DATA TRANSFORMATION, SQUARE ROOT

It is often desirable to perform transformations on raw data, and then to consider the associated statistics. The transformation can be easily programmed. The following program treats a common transformation - The Square Root. Other procedures could be employed, using this program as a model.

Computer Design Corporation
12401 West Olympic Boulevard, Los Angeles, California 90064
EXAMPLE: For the data: 105, 13, 29.3, 79.6, 51, find the SD and mean for both the raw data and its transform.

1. CLEAR GROUP RX SET UP 3

2. RUN

3. START

4. Enter next X

5. SD MEAN, read 2.658, the SD of the transformed data

6. SD MEAN, read 37.228, the SD of the raw data

Next problem:

1. CLEAR GROUP RX

2. Enter the data values, pressing START after each

3. SD MEAN and 2ND FUNC for SD and Mean of the transformed data

4. SD MEAN and 2ND FUNC for the SD and Mean of the raw data.
SPEARMAN'S RANK-ORDER CORRELATION (rho)

An estimate of the relationship between two sets (X & Y) of ranked data can be obtained by calculating rho.

\[ \rho = 1 - \frac{6 \sum D_i^2}{N^3 - N} \]

\[ D_i = X_i - Y_i \]

X = ranked data item

Y = ranked data item

N = number of data pairs
**EXAMPLE**

To calculate rho when: 

<table>
<thead>
<tr>
<th>X</th>
<th>Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>5</td>
<td>6</td>
</tr>
</tbody>
</table>

1. **CLEAR GROUP**

2. Enter $X_i$, Enter $Y_i$.

Repeat step 2 for all $X, Y$ pairs.

3. **LOAD**

   **rho = 0.771**

---

**NEXT PROBLEM**

<table>
<thead>
<tr>
<th>X</th>
<th>Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>5</td>
<td>6</td>
</tr>
</tbody>
</table>

1. **CLEAR GROUP**

2. Enter $X_i$, Enter $Y_i$.

Repeat step 2 for all $X, Y$ pairs.

3. **START STOP**

   Read rho in the display.

   For a new set of data, return to step 1.
t-TEST, SAMPLE VERSUS POPULATION MEAN

Given a population mean ($\mu$), this program yields a value for $t$ forming a comparison with the sample mean ($X$).

\[ t = \frac{X - \mu}{\sqrt{\frac{\sum X^2 - (\sum X)^2}{N(N-1)}}} \]

\[ = \frac{X - \mu}{SD \sqrt{N}} \]

\[ df = N - 1 \]
**T-TEST, SAMPLE VERSUS POPULATION MEAN**

**EXAMPLE:** With \( \mu = 100 \), what is \( t \) for 98, 105, 107, 106, 100?

1. Enter \( \mu \)  
   - **LOAD**  
   - **CLEAR GROUP**

2. Enter \( X_1 \), Repeat step 2 for all \( X_1 \).

3. Enter \( \mu \)  
   - **START STOP**

4. Load program from facing page  
   - \( t = 1.805 \), \( df = 4 \)

**NEXT PROBLEM:**

1. **LOAD**  
   - **CLEAR GROUP**

2. Enter \( X_1 \), Repeat step 2 for all \( X_1 \).

3. Enter \( \mu \), read \( t \);  
   - **START STOP**  
   - read \( df \)

4. \( S \), read \( SD \);  
   - **START STOP**  
   - read \( X \). Return to step 1 for next problem.