Examples

1-Sample Z Test

Set Up

1. On the icon menu, select STAT2.

Execution

2. When using list data (List is selected as the Data parameter), be sure to input data into the list first.
3. F3 (TEST) 1 (Z) 1 (1-Smpl) ... 1-Sample Z Test
4. Set calculation parameters.
5. Align the cursor with [Execute]

   F1 (CALC) ... Performs calculation.

   F6 (DRAW) ... Draws graph.

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Example **Five new members of a football team are timed for the 100-meter dash, yielding the following times.**

A: 12.5 B: 11.6 C: 10.8 D: 12.8 E: 11.4

The average time of current team members is 11.4 seconds, with a standard deviation of 1.30. Test the null hypothesis that the times of the five new members are at the same level as current team members at the 0.05 level of significance.

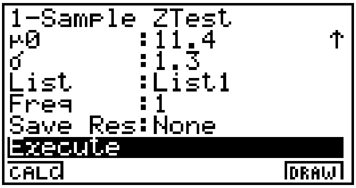
Procedure

① [MENU] STAT2

② [1] [2] [•] [5] [EXE] [1] [1] [•] [6] [EXE] [1] [0] [•] [8] [EXE]
[1] [2] [•] [8] [EXE] [1] [1] [•] [4] [EXE]

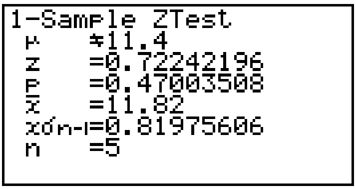
③ [F3](TEST) [1](Z) [1](1-Smpl)

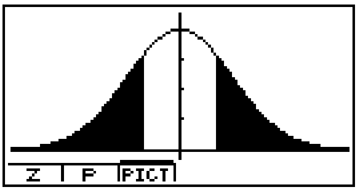
④ [F1](LIST) [▼]
[F1](≠) [▼]
[1] [1] [•] [4] [EXE]
[1] [•] [3] [EXE]
[F1](LIST) [1] [EXE] [▼]
[F1](1) [▼]
[F1](None) [▼]



⑤ [F1](CALC)
[F6](DRAW)

Result Screen





Since P = 0.47003508 > 0.05 (level of significance), we can't reject the null hypothesis and can conclude the times of the five new numbers is at the same level as current team members.

■ 2-Sample Z Test

Set Up

1. On the icon menu, select STAT2.

Execution

2. When using list data (List is selected as the Data parameter) , be sure to input data into the list first.
3. [F3] (TEST) [1] (Z) [2] (2-Smpl) ... 2-Sample Z Test
4. Set calculation parameters.
5. Align the cursor with [Execute]

   [F1] (CALC) ... Performs calculation.

   [F6] (DRAW) ... Draws graph.

• • • • •

Example **A consumer group is testing camp stoves. To test the heating capacity of a stove they measure the time required to bring 2 qt of water from 50°F to boiling (at sea level). Two competing models are under consideration. 36 stoves of each model were tested and the following results were obtained.**

Model 1: mean time $\bar{x}_1$ = 11.5min; standard deviation σ_1= 2.4min

Model 2: mean time $\bar{x}_2$ = 10 min; standard deviation σ_2= 3 min

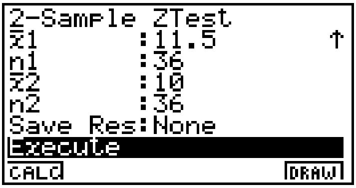
Is there any difference between the performances of these two models? (Use a 5% level of significance.)

Procedure

① MENU STAT2

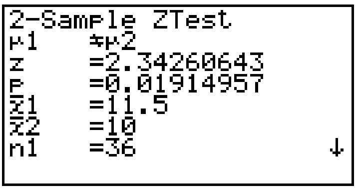
② F3 (TEST) 1 (Z) 2 (2-Smpl)

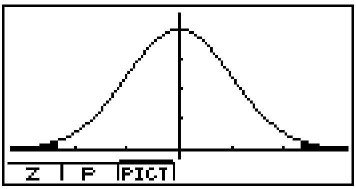
③ F2 (VAR) ▼
F1 (≠) ▼
2 . 4 EXE
3 EXE
1 1 . 5 EXE
3 6 EXE
1 0 EXE
3 6 EXE
F1 (None) ▼



④ F1 (CALC)
F6 (DRAW)

Result Screen





Since P = 0.01914957 < 0.05 (level of significance), we reject the null hypothesis µ1-µ2 =0 and conclude the performances of the two models are different.

1-Prop Z Test

Set Up

1. On the icon menu, select STAT2.

Execution

2. F3(TEST) 1(Z) 3(1-Prop) ... 1-Prop Z Test
3. Set calculation parameters.
4. Align the cursor with [Execute]

   F1(CALC) ... Performs calculation.

   F6(DRAW) ... Draws graph.

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Example **A team of eye surgeons has developed a new technique for a risky eye operation to restore the sight of people blinded from a certain disease. Under the old method it is known that only 30% of the patients who undergo this operation recover their eyesight. Suppose that surgeons in various hospitals have performed a total of 250 operations using the new method and that 93 have been successful (the patients fully recovered their sight). Can we justify the claim that the new method is better than the old one?(Use a 1% level of significance.)**

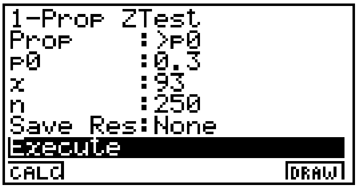
Procedure

① [MENU] STAT2

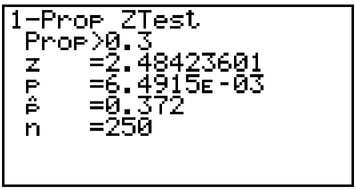
② [F3] (TEST) [1] (Z) [3] (1-Prop)

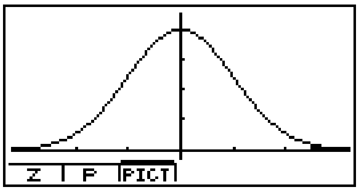
③ [F3] (>) [▼]
[•] [3] [EXE]
[9] [3] [EXE]
[2] [5] [0] [EXE]
[F1] (None) [▼]

④ [F1] (CALC)
[F6] (DRAW)



Result Screen





Since P = 6.4915e-3 < 0.01 (level of significance), we can reject the null hypothesis that the successful probability of new operation is 0.3 and conclude that it can be said the new method obtains good results more than existing method. That is to say it is more effective by new methods.

2-Prop Z Test

Set Up

1. On the icon menu, select STAT2.

Execution

2. F3 (TEST) 1 (Z) 4 (2-Prop) ... 2-Prop Z Test
3. Set calculation parameters.
4. Align the cursor with [Execute]

   F1 (CALC) ... Performs calculation.

   F6 (DRAW) ... Draws graph.

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Example **The County Clerk wishes to improve voter registration. One method under consideration is to send reminders in the mail to all citizens in the county who are eligible to register. As a pilot study to determine if this method will actually improve voter registration, a random sample of 1224 potential voters was taken. Then this sample was randomly divided into two groups.**

Group A : There were 612 people in this group. No reminders to register were sent to them. The number of potential voters from this group who registered was 280.

Group B : This group also contained 612 people. Reminders were sent in the mail to each member in the group, and the number who registered to vote was 335.

The County Clerk claims that the proportion of people to register was significantly greater in group B. On the basis of this claim the clerk recommends that the project be funded for the entire population of Macek County. Use 5% level of significance to test the claim that the proportion of potential voters who registered was greater in group B, the group that received reminders.

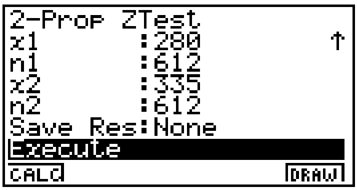
Procedure

① MENU STAT2

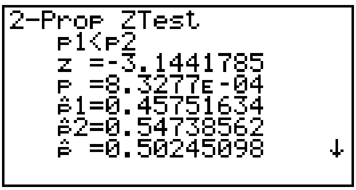
② F3 (TEST) 1 (Z) 4 (2-Prop)

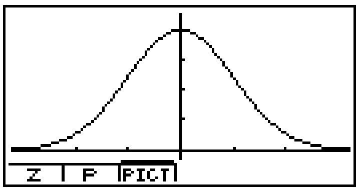
③ F2 (<) ▼
2 8 0 EXE
6 1 2 EXE
3 3 5 EXE
6 1 2 EXE
F1 (None) ▼

④ F1 (CALC)
F6 (DRAW)



Result Screen





Since P = 8.3277e-4 < 0.05 (level of significance), we can reject the null hypothesis ($P_1 \geqq P_2$) and conclude that the County Clerk‘s claim is valid at the 0.05 level of significance.

1-Sample *t* Test

Set Up

1. On the icon menu, select STAT2.

Execution

2. When using list data (List is selected as the Data parameter), be sure to input data into the list first.
3. F3 (TEST) 2 (T) 1 (1-Smpl) ... 1-Sample *t* Test
4. Set calculation parameters.
5. Align the cursor with [Execute]

   F1 (CALC) ... Performs calculation.

   F6 (DRAW) ... Draws graph.

• • • • •

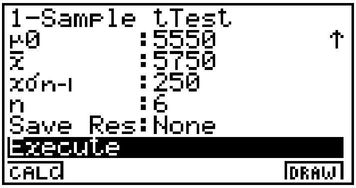
Example **A company manufactures large rocket engines used to project satellites into space. The government buys the rockets, and the contract specifies that these engines are to use an average of 5550 lb of rocket fuel the first 15 sec operation. The company claims their engines fit specifications. To test the claim an inspector randomly selects six such engines from the warehouse. These 6 engines are fired 15 sec each and the fuel consumption for each engine is measured. For all six engines, the mean fuel consumption is $\bar{x}$ = 5750 pounds and the standard deviation is $x\sigma_{n-1}$ = 250 lb. Is the claim justified at the 5% level of significance?**

Procedure

① [MENU] STAT2

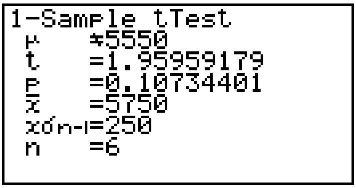
② [F3] (TEST) [2] (T) [1] (1-Smpl)

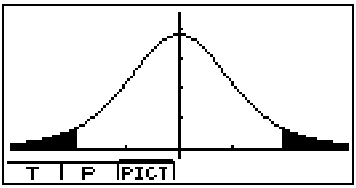
③ [F2] (VAR) [▼]
[F1] (≠) [▼]
[5] [5] [5] [0] [EXE]
[5] [7] [5] [0] [EXE]
[2] [5] [0] [EXE]
[6] [EXE]
[F1] (None) [▼]



④ [F1] (CALC)
[F6] (DRAW)

Result Screen





Since P = 0.107344401 > 0.05 (level of significance), we can't reject the null hypothesis μ=5550 and conclude that the data does not present sufficient evidence to indicate that the average fuel consumption from the first 15 seconds of operation is different from μ =5550.

■ 2-Sample *t* Test (Pooled On)

Set Up

1. On the icon menu, select STAT2.

Execution

2. When using list data (List is selected as the Data parameter), be sure to input data into the list first.
3. [F3](TEST) [2](T) [2](2-Smpl) ... 2-Sample *t* Test
4. Set calculation parameters.
5. Align the cursor with [Execute]

   [F1](CALC) ... Performs calculation.

   [F6](DRAW) ... Draws graph.

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Example **Two different processes (Type A and Type B) are used to produce tinplate. The following values show the weights of samples produced by each process.**

Type A:	**105**	**108**	**86**	**103**	**103**	**107**	**124**	**124**
Type B:	**89**	**92**	**84**	**97**	**103**	**107**	**111**	**97**

Using the level of significance 0.05, test the null hypothesis that the tinplate produced by the two processes are of the same level.

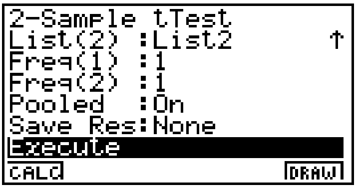
Procedure

① [MENU] STAT2

② [1] [0] [5] [EXE] [1] [0] [8] [EXE] [8] [6] [EXE] [1] [0] [3] [EXE]
[1] [0] [3] [EXE] [1] [0] [7] [EXE] [1] [2] [4] [EXE] [1] [2] [4] [EXE]
[▶]
[8] [9] [EXE] [9] [2] [EXE] [8] [4] [EXE] [9] [7] [EXE]
[1] [0] [3] [EXE] [1] [0] [7] [EXE] [1] [1] [1] [EXE] [9] [7] [EXE]

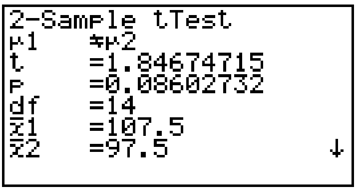
③ [F3](TEST) [2](T) [2](2-Smpl)

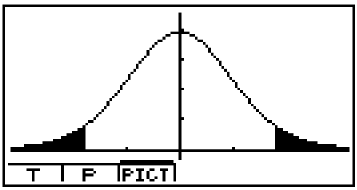
④ [F1](LIST) [▼]
[F1](≠) [▼]
[F1](LIST) [1] [EXE] [▼]
[F1](LIST) [2] [EXE] [▼]
[F1](1) [▼]
[F1](1) [▼]
[F1](On) [▼]
[F1](None) [▼]



⑤ [F1](CALC)
[F6](DRAW)

Result Screen





Since P = 0.08602732 > 0.05 (level of significance), we can not reject the null hypothesis and conclude that the tinplate produced by the two processes are of the same level.

2-Sample t Test (Pooled Off)

Set Up

1. On the icon menu, select STAT2.

Execution

2. When using list data (List is selected as the Data parameter) , be sure to input data into the list first.
3. [F3] (TEST) [2] (T) [2] (2-Smpl) ... 2-Sample t Test
4. Set calculation parameters.
5. Align the cursor with [Execute]

   [F1] (CALC) ... Performs calculation.

   [F6] (DRAW) ... Draws graph.

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Example **Two competing headache remedies claim to give fast-acting relief. An experiment was performed to compare the mean lengths of time required for bodily absorption of brand A and brand B headache remedies. 12 people were randomly selected and given an oral dosage of brand A. Another 12 were randomly selected and given an equal dosage of brand B. The length of time in minutes for the drugs to reach a specified level in the blood was recorded. The means, standard deviations, and sizes of the two samples follow;**

Brand A: $\bar{x}1$ = 19.8; x1$\sigma_{n\text{-}1}$ = 8.6; n1 = 12

Brand B: $\bar{x}2$ = 19 ; x2$\sigma_{n\text{-}1}$ = 6 ; n2 = 12

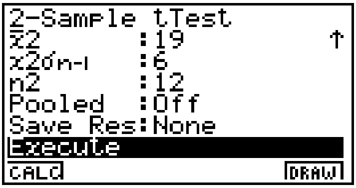
Past experience with the drug composition of the two remedies permits researchers to assume the standard deviations of the two time distributions are approximately equal. Let us use a 5% level of significance to test the null hypothesis that there is no difference in the mean time required for bodily absorption.

Procedure

① [MENU] STAT2

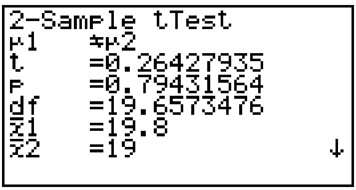
② [F3](TEST) [2](T) [2](2-Smpl)

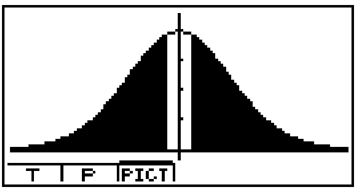
③ [F2](VAR) [▼]
[F1](≠) [▼]
[1] [9] [·] [8] [EXE]
[8] [·] [6] [EXE]
[1] [2] [EXE]
[1] [9] [EXE]
[6] [EXE]
[1] [2] [EXE]
[F2](Off) [▼]
[F1](None) [▼]



④ [F1](CALC)
[F6](DRAW)

Result Screen





Since P = 0.79431564 > 0.05 (level of significance), the difference is in acceptance region. We conclude that the data does not contain sufficient evidence to reject H_0. Therefore, at the 5% level of significance we conclude that there is no difference in the mean times.

LinearReg *t* Test

Set Up

1. On the icon menu, select STAT2.

Execution

2. Input data into the list.
3. F3 (TEST) 2 (T) 3 (LinReg) ... LinearReg *t* Test
4. Set calculation parameters.
5. Align the cursor with [Execute]

   F1 (CALC) ... Performs calculation.

• • • • •

Example **A survey conducted by a city on its real estate investments revealed the following data on the relationship between area and price.**
Does the data indicate that the value β_1, that is, the slope of the population regression line, is not zero, which would mean that x (Area) can be use as a predictor of y (Sales Price)? Use a 5% level of significance.

x Area (square feet)	9	15	10	11	10
y Sales Price (× $1000)	36	80	44	55	35

Procedure

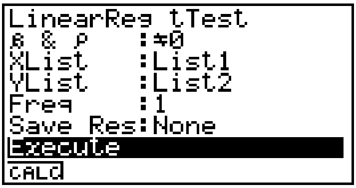
① [MENU] STAT2

② [9] [EXE] [1] [5] [EXE] [1] [0] [EXE] [1] [1] [EXE] [1] [0] [EXE]
[▶]
[3] [6] [EXE] [8] [0] [EXE] [4] [4] [EXE] [5] [5] [EXE] [3] [5] [EXE]

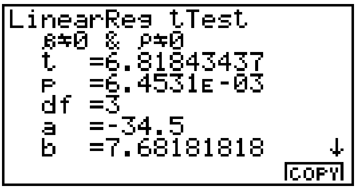
③ [F3](TEST) [2](T) [3](LinReg)

④ [F1](≠) [▼]
[F1](LIST) [1] [EXE] [▼]
[F1](LIST) [2] [EXE] [▼]
[F1](1) [▼]
[F1](None) [▼]

⑤ [F1](CALC)



Result Screen



Since P = 6.4531e-3 < 0.05 (level of significance), we can reject the null hypothesis $\beta_1 \neq 0$ and conclude that there is a linear relationship $y = \beta_0 + \beta_1 x + \varepsilon$ between area(x) and price(y).

■ χ^2 Test

Set Up

1. On the icon menu, select STAT2.

Execution

2. F3 (TEST) 3 (χ^2)... χ^2 Test
3. Input data into the Matrix.
4. Set calculation parameters.
5. Align the cursor with [Execute]

   F1 (CALC) ... Performs calculation.

   F6 (DRAW) ... Draws graph.

Example **A certain club collected data on the attendance at meetings by married status, and obtained the data shown below.**

	Married	Divorced	Widowed	Single	Row Totals
Often Absent	**34**	**16**	**14**	**36**	**100**
Seldom Absent	**64**	**34**	**20**	**82**	**200**
Never Absent	**52**	**50**	**16**	**82**	**200**
Column Totals	**150**	**100**	**50**	**200**	**500**

Test the null hypothesis that two phenomena are independent using the level of significance of 0.05.

Procedure

① [MENU] STAT2

② [F3](TEST) [3](χ^2)

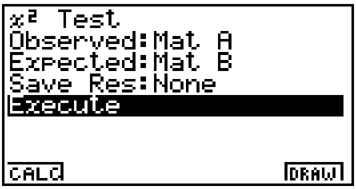
③ [F2](▶MAT)
[F1](DIM)
[3] [EXE]
[4] [EXE] [EXE]

[3] [4] [EXE] [1] [6] [EXE] [1] [4] [EXE] [3] [6] [EXE]
[6] [4] [EXE] [3] [4] [EXE] [2] [0] [EXE] [8] [2] [EXE]
[5] [2] [EXE] [5] [0] [EXE] [1] [6] [EXE] [8] [2] [EXE]

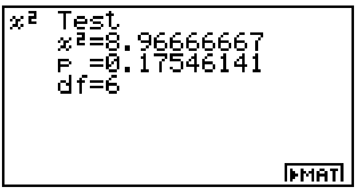
[ESC] [ESC]

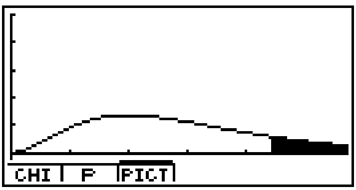
④ [F1](MAT) [X,θ,T](A) [EXE] [▼]
[F1](MAT) [log](B) [EXE] [▼]
[F1](None) [▼]

⑤ [F1](CALC)
[F6](DRAW)



Result Screen





Since P = 0.17546141 > 0.05 (level of significance), we can not reject the null hypothesis and conclude that there the two phenomena are independent of each other.

2-Sample F Test

Set Up

1. On the icon menu, select STAT2.

Execution

2. When using list data (List is selected as the Data parameter), be sure to input data into the list first.
3. F3 (TEST) 4 (F)... 2-Sample F Test
4. Set calculation parameters.
5. Align the cursor with [Execute]

   F1 (CALC) ... Performs calculation.

   F6 (DRAW) ... Draws graph.

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Example **There are two possible routes to get to the airport from a certain company, and so manager wants to determine which route is the fastest in order to make a plane that leaves at 7 o'clock. One route was researched five times and then the other route was researched five times, producing the data shown below.**

mean of x1 = 33.8min mean of x2 = 34.2min
x1σ_{n-1} = 16.4min x2σ_{n-1} = 6.1min

Test the null hypothesis that the two routes have the same travel time variance using the level of significance of 0.10.

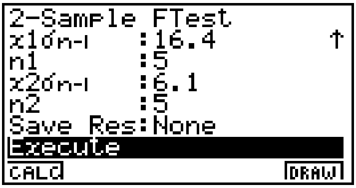
Procedure

① MENU STAT2

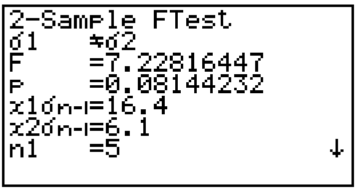
② F3 (TEST) 4 (*F*)

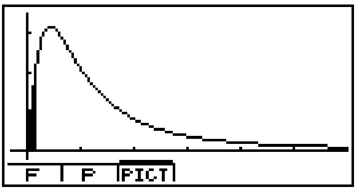
③ F2 (VAR) ▼
F1 (≠) ▼
1 6 · 4 EXE
5 EXE
6 · 1 EXE
5 EXE
F1 (None) ▼

④ F1 (CALC)
F6 (DRAW)



Result Screen





Since P = 0.08144232 < 0.1 (level of significance), we can reject the null hypothesis and conclude that two routes don’t have same travel time variance.

One-Way ANOVA

Set Up

1. On the icon menu, select STAT2.

Execution

2. Input data into the list.
3. F3 (TEST) 5 (ANOVA) ... Analysis of Variance (ANOVA)
4. Set calculation parameters. Specify 1 for How Many setting.
5. Align the cursor with [Execute]
   F1 (CALC) ... Performs calculation.

• • • • •

Example **A psychologist is studying pattern recognition skills under four laboratory settings. In each setting, a fourth-grade child is given a pattern recognition test with ten patterns to identify. In setting A, the child is given praise for each correct answer and no comment about wrong answers. In setting B, the child is given criticism for each wrong answer and no comment about correct answers. In setting C, the child is given no praise or criticism but the observer expresses interest in what the child is doing. In setting D, the observer remains silent in an adjacent room watching the child through a one-way mirror. A random sample of fourth-grade children was used, and each child participated in the test only once. The test scores (number correct) for each group follow. Find $F_{0.01}$, the critical values for an α = 0.01 level of significance. Does the test indicate we should accept or reject the null hypothesis?**

Group A = {10, 8, 7, 9, 11}
Group B = { 2, 5, 3, 3, 4}
Group C = { 9, 3, 7, 8, 5, 6}
Group D = { 5, 7, 3, 6, 7}

Procedure

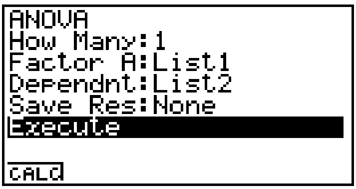
① MENU STAT2

② 1 EXE 1 EXE 1 EXE 1 EXE 1 EXE 2 EXE 2 EXE 2 EXE 2 EXE 2 EXE
3 EXE 3 EXE 3 EXE 3 EXE 3 EXE 3 EXE 4 EXE 4 EXE 4 EXE 4 EXE 4 EXE
▶
1 0 EXE 8 EXE 7 EXE 9 EXE 1 1 EXE 2 EXE 5 EXE 3 EXE 3 EXE 4 EXE
9 EXE 3 EXE 7 EXE 8 EXE 5 EXE 6 EXE 5 EXE 7 EXE 3 EXE 6 EXE 7 EXE

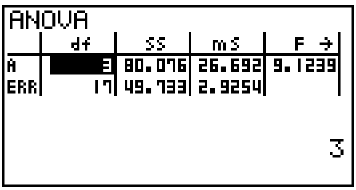
③ F3 (TEST) 5 (ANOVA)

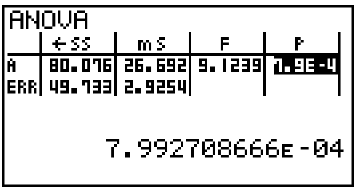
④ F1 (1) ▼
F1 (LIST) 1 EXE ▼
F1 (LIST) 2 EXE ▼
F1 (None) ▼

⑤ F1 (CALC)



Result Screen





Since P = 7.992708666e-4 < 0.01 (level of significance), we can reject the null hypothesis and conclude that the laboratory setting affects the mean score.

Two-Way ANOVA

Set Up

1. On the icon menu, select STAT2.

Execution

2. Input data into the list.
3. F3 (TEST) 5 (ANOVA) ... Analysis of Variance (ANOVA)
4. Set calculation parameters. Specify 2 for How Many setting.
5. Align the cursor with [Execute]
   F1 (CALC) ... Performs calculation.
   F6 (DRAW) ... Draws graph

● ● ● ● ●

Example **The nearby table shows measurement results for a metal product produced by a heat treatment process based on two treatment levels: time (A) and temperature (B). The experiments were repeated twice each under identical conditions.**

B (Heat Treatment Temperature) A (Time)	B1	B2
A1	113 , 116	139 , 132
A2	133 , 131	126 , 122

Perform analysis of variance on the following null hypothesis, using a significance level of 5%.

H_0 : No change in strength due to time
H_0 : No change in strength due to heat treatment temperature
H_0 : No change in strength due to interaction of time and heat treatment temperature

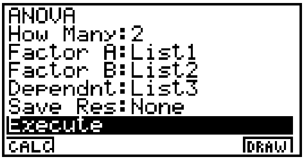
Procedure

① MENU STAT2

② 1 EXE 1 EXE 1 EXE 1 EXE 2 EXE 2 EXE 2 EXE 2 EXE ▶
1 EXE 1 EXE 2 EXE 2 EXE 1 EXE 1 EXE 2 EXE 2 EXE ▶
1 1 3 EXE 1 1 6 EXE 1 3 9 EXE 1 3 2 EXE 1 3 3 EXE 1 3
1 EXE 1 2 6 EXE 1 2 2 EXE

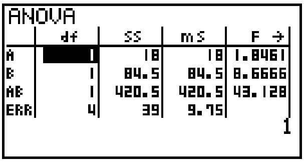
③ F3(TEST) 5(ANOVA)

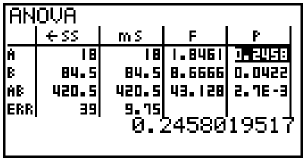
④ F2(2) ▼
F1(LIST) 1 EXE ▼
F1(LIST) 2 EXE ▼
F1(LIST) 3 EXE ▼
F1(None) ▼

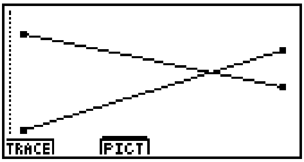


⑤ F1(CALC)
F6(DRAW)

Result Screen







- Time differential (A) :

  Since P=0.2458019517 > 0.05 (level of significance), we can not reject the null hypothesis.

- Temperature differential (B) :

  Since P=0.04222398836 < 0.05 (level of significance), we can reject the null hypothesis.

- Interaction (A × B) :

  Since P=2.78169946e-3 < 0.05 (level of significance), we can reject the null hypothesis.

The above test indicates that the time differential is not significant, the temperature differential is significant, and interaction is highly significant.