9

Inference aplet

About the Inference aplet

The Inference capabilities include calculation of confidence intervals and hypothesis tests based on the Normal Z-distribution or Student's t-distribution.

Based on the statistics from one or two samples, you can test hypotheses and find confidence intervals for the following quantities:

- mean
- proportion
- difference between two means
- difference between two proportions

Example data

When you first access an input form for an Inference test, by default the input form contains example data. This example data is designed to return meaningful results that relate to the test. It is useful for gaining an understanding of what the test does, and for demonstrating the test. The calculator's on-line help provides a description of what the example data represents.

Getting started with the Inference aplet

This example describes the Inference aplet's options and functionality by stepping you through an example using the example data for the Z-Test on 1 mean.

Open the Inference aplet

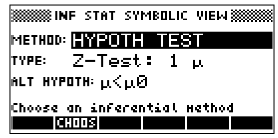
1. Open the Inference aplet.

APLET

Select `Inferential`

START.

The Inference aplet opens in the Symbolic view.



Inference aplet's SYMB view keys

The table below summarizes the options available in Symbolic view**.**

Hypothesis Tests	**Confidence Intervals**
Z: 1 μ, the Z-Test on 1 mean	Z-Int: 1 μ, the confidence interval for 1 mean, based on the Normal distribution
Z: μ_1 - μ_2, the Z-Test on the difference of two means	Z-Int: μ_1 - μ_2, the confidence interval for the difference of two means, based on the Normal distribution
Z: 1 P, the Z-Test on 1 proportion	Z-Int: 1 P, the confidence interval for 1 proportion, based on the Normal distribution
Z: P_1 – P_2, the Z-Test on the difference in two proportions	Z-Int: P_1 – P_2, the confidence interval for the difference of two proportions, based on the Normal distribution
T: 1 μ, the T-Test on 1 mean	T-Int: 1 μ, the confidence interval for 1 mean, based on the Student's t-distribution
T: μ_1 - μ_2, the T-Test on the difference of two means	T-Int: μ_1 - μ_2, the confidence interval for the difference of two means, based on the Student's t-distribution

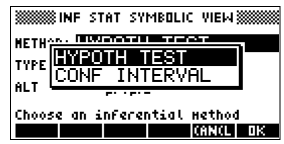
If you choose one of the hypothesis tests, an `Alt. Hypoth.` field lets you choose the alternative hypothesis to test against the null hypothesis. For each test, there are three possible choices for an alternative hypothesis based on a quantitative comparison of two quantities. The null hypothesis is always that the two quantities are equal.Thus, the alternative hypotheses cover the various cases for the two quantities being unequal: <, >, and ≠.

In this section, we will use the example data for the Z-Test on 1 mean to illustrate how the aplet works and what features the various views present.

Define the inferential method

1. Select the `Hypothesis Test` inferential method.

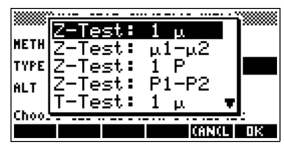
   CHOOS
   Select `HYPOTH TEST`



2. Define the distribution statistic.

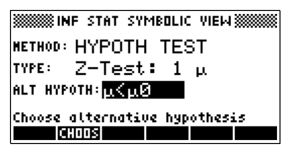
   OK ▼
   CHOOS
   `Z-Test: 1 µ`

   Note the arrow at the bottom of the option list indicating more options to which you may scroll.



3. Select an alternative hypothesis.

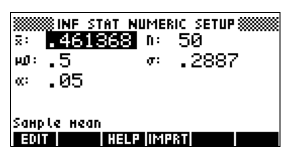
   OK ▼
   CHOOS
   µ< µ 0
   OK



Enter data

4. Enter the sample statistics and population parameters that define the chosen test or interval.

   SHIFT *SETUP-NUM*



   The table below summarizes the fields in this view for our current `Z-Test`: 1 µ example.

Field name	Definition
µ0	Assumed population mean
s	Population standard deviation
C	Sample mean
n	Sample size

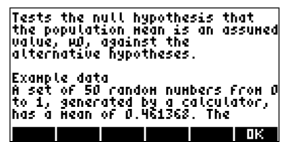
Field name	Definition (Continued)
a	Alpha level for the test

By default, each field already contains a value. These values constitute the example database and are explained in the **HELP** feature of this aplet.

Display on-line help

5. Display the on-line help.

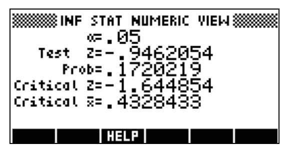
HELP



Display test results in numeric format

6. Display the test results in numeric format.

NUM



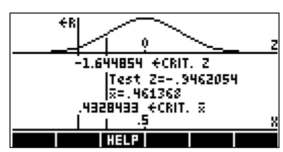
The test distribution value and its associated probability are displayed, along with the critical value(s) of the test and the associated critical value(s) of the statistic.

Note: You can access the Help Note in Numeric view.

Plot test results

7. Display a graphic view of the test results.

PLOT



Horizontal axes are presented for both the distribution variable and the test statistic. A generic “bell curve” represents the probability distribution function. Vertical lines mark the critical value(s) of the test, as well as the value of the test statistic. The rejection region is clearly marked and the test numeric results are displayed between the horizontal axes.

Note: You can display the on-line help for the Plot view by pressing the **HELP** *menu key.*

Importing Sample Statistics from the Statistics aplet

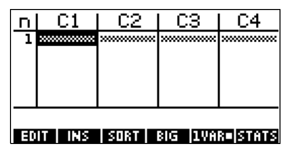
The Inference aplet supports the calculation of confidence intervals and the testing of hypotheses based on data in the Statistics aplet. Statistics on a sample of data contained in a column of data in any Statistics-based aplet can be imported for use in the Inference aplet. The following example will illustrate the process.

A calculator produces the following 6 random numbers:

0.529, 0.295, 0.952, 0.259, 0.925, and 0.592

1. Open Statistics aplet. *Note: Reset current settings.*

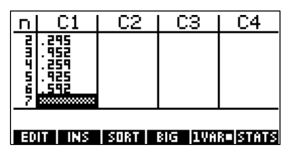
   [APLET] *Select* `Statistics`
   RESET
   START

   The Statistics aplet opens in the Numeric view.

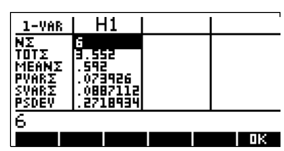
2. Enter random numbers in the C1 column.

   [.]529 [ENTER]
   [.]295 [ENTER]
   [.]952 [ENTER]
   [.]259 [ENTER]
   [.]925 [ENTER]
   [.]592 [ENTER]

3. Calculate statistics. *Note: Ensure the* **1VAR/2VAR** *menu key toggled to* **1VAR.**

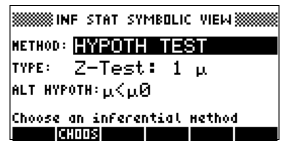
   STATS
   OK

   The mean of 0.592 seems a little large compared to the expected value of 0.5. To see if the difference is statistically significant, we will use the statistics computed here to construct a confidence interval for the true mean of the population of random numbers and see whether or not this interval contains 0.5.

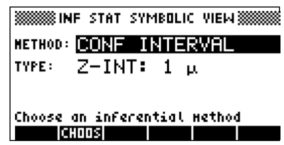
4. Open the Inference aplet. *Note: Clear current settings.*

APLET *Select* `Inference`
RESET
START



5. Choose an inference method.

   CHOOS
   Select `CONF INTERVAL`
   OK

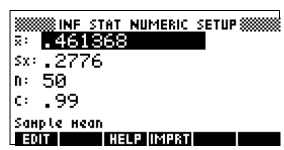


6. Choose a distribution statistic.

   ▼ **CHOOS**
   Select `T-Int: 1 μ`
   OK

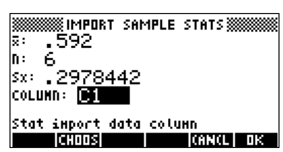
7. Set up the interval calculation. *Note: The fields current hold the sample data from the on-line help example.*

   SHIFT *SETUP-NUM*



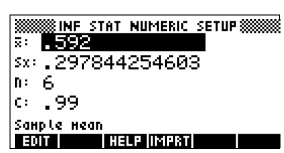
8. Import the data from the Statistics aplet into the Inference aplet. *Note: The data from C1 precedes us by default.*

   IMPRT



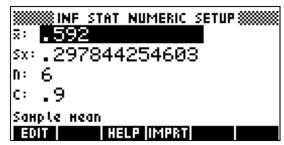
   Note: If there were other columns of data in the Statistics aplet, you could select a column and press the **OK** *key to see the statistics before actually importing them into the Numeric Setup view. Also, if there were more than one aplet based on the Statistics aplet, you would be prompted to choose one.*

   OK



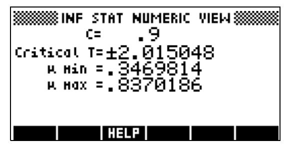
9. Specify a 90% confidence interval.

   [▼] *to move to the* `C:` *field*
   0.9 [ENTER]



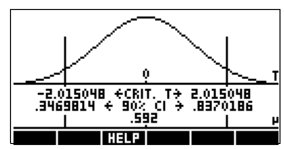
10. Display the confidence interval in the Numeric view. *Note: The interval setting is 0.5.*

    [NUM]



11. Display the confidence interval in the Plot view.

    [PLOT]



Note: The graph is a simple, generic bell-curve. It is not meant to accurately represent the t-distribution with 5 degrees of freedom.

Hypothesis tests

You use hypothesis tests to test the validity of hypotheses that relate to the statistical parameters of one or two population. The tests are based on statistics from samples of the population.

The HP 39G/40G hypothesis tests use the Normal Z-distribution or Student's t-distribution to calculate probabilities.

One-Sample Z-Test

Menu name

Z–Test: 1 μ

On the basis of statistics from a single sample, the 1 mean Z-Test measures the strength of the evidence for a selected hypothesis against the null hypothesis. The null hypothesis is that the population mean equals a specified value H0: μ –μ0.

You select one of the following alternative hypotheses against which to test the null hypothesis:

$$H_1{:}\mu < \mu_0$$
$$H_1{:}\mu > \mu_0$$
$$H_1{:}\mu \neq \mu_0$$

Inputs

Field name	Definition
μ_0	Hypothetical population mean.
σ	Population standard deviation.
$\bar{x}$	Sample mean.
n	Sample size.
α	Significance level.

Results

Result	Description
Prob	Probability associated with the Z-Test statistic.
Critical Z	Boundary values of Z associated with the α level that you supplied.
Critical $\bar{x}$	Boundary values of $\bar{x}$ required by the α value that you supplied.

Two-Sample Z-Test

Menu name

Z–Test: 1–μ2

On the basis of two samples, each from a separate population, this test measures the strength of the evidence for a selected hypothesis against the null hypothesis. The null hypothesis is that the mean of the two populations are equal (H_0: $\mu_1 = \mu_2$).

You select one of the following alternative hypotheses against which to test the null hypothesis:

$$H_1 : \mu_1 < \mu_2$$
$$H_1 : \mu_1 > \mu_2$$
$$H_1 : \mu_1 \neq \mu_2$$

Inputs

Field name	**Definition**
$\bar{x}1$	Sample 1 mean.
$\bar{x}2$	Sample 2 mean.
σ1	Population 1 standard deviation.
σ2	Population 2 standard deviation.
n1	Sample 1 size.
n2	Sample 2 size.
α	Significance level.

Results

Result	**Description**
Test Z	Z-Test statistic
Prob	Probability associated with the Z-Test statistic.
Critical Z	Boundary value of Z associated with the α level that you supplied.

One-Proportion Z-Test

Menu name

Z-Test: 1π

On the basis of statistics from a single sample, this test measures the strength of the evidence for a selected hypothesis against the null hypothesis. The null hypothesis is that the proportion of successes in the two populations are equal.

$$H0\pi = \pi_0$$

You select one of the following alternative hypotheses against which to test the null hypothesis:

$$H_1{:}\pi < \pi_0$$
$$H_1{:}\pi > \pi_0$$
$$H_1{:}\pi \neq \pi_0$$

Inputs

Field name	Definition
π_0	Population proportion of successes.
x	Number of successes in the sample.
n	Sample size.
α	Significance level.

Results

Result	Description
Test P	Proportion of successes in the sample.
Test Z	Z-Test statistic.
Prob	Probability associated with the Z-Test statistic.
Critical Z	Boundary value of Z associated with the level you supplied.

Two-Proportion Z-Test

Menu name

Z-Test: P1–P2

On the basis of statistics from two samples, each from a different population, the 2 proportion Z-Test measures the strength of the evidence for a selected hypothesis against the null hypothesis. The null hypothesis is that the proportion of successes in the two populations are equal.
(H_0: $\pi_1 = \pi_2$).

You select one of the following alternative hypotheses against which to test the null hypothesis:

$$H_1 : \pi_1 < \pi_2$$
$$H_1 : \pi_1 > \pi_2$$
$$H_1 : \pi_1 \neq \pi_2$$

Inputs

Field name	Definition
X1	Sample 1 mean.
X2	Sample 2 mean.
n1	Sample 1 size.
n2	Sample 2 size.
α	Significance level.

Results

Result	Description
Test P1–P2	Difference between the proportions of successes in the two samples.
Test Z	Z-Test statistic.
Prob	Probability associated with the Z-Test statistic.
Critical Z	Boundary values of Z associated with the α level that you supplied.

One-Sample T-Test

Menu name

T-Test: 1 μ

The One-sample T-Test is used when the population standard deviation is not known. On the basis of statistics from a single sample, this test measures the strength of the evidence for a selected hypothesis against the null hypothesis. The null hypothesis is that the sample mean has some assumed value, H0 :μ = μ0

You select one of the following alternative hypotheses against which to test the null hypothesis:)

$$H_1 : \mu < \mu_0$$
$$H_1 : \mu > \mu_0$$
$$H_1 : \mu \neq \mu_0$$

Inputs

Field name	Definition
μ0	Hypothetical population mean.
n	Sample size.
$\bar{x}$	Sample mean.
Sx	Sample standard deviation.
α	Significance level.

Results

Result	Description
Test T	T-Test statistic.
Prob	Probability associated with the T-Test statistic.
Critical T	Boundary value of T associated with the α level that you supplied.
Critical $\bar{x}$	Boundary value of $\bar{x}$ required by the α value that you supplied.

Two-Sample T-Test

Menu name

T-Test: μ1 – μ2

The Two-sample T-Test is used when the population standard deviation is not known. On the basis of statistics from two samples, each sample from a different population, this test measures the strength of the evidence for a selected hypothesis against the null hypothesis. The null hypothesis is that the two populations are equal (H_0: $\mu_1 = \mu_2$).

You select one of the following alternative hypotheses against which to test the null hypothesis

$$H_1: \mu_1 < \mu_2$$
$$H_1: \mu_1 > \mu_2$$
$$H_1: \mu_1 \neq \mu_2$$

Inputs

Field name	**Definition**
$\bar{x}$ 1	Sample 1 mean.
$\bar{x}$ 2	Sample 2 mean.
S1	Sample 1 standard deviation.
S2	Sample 2 standard deviation.
n1	Sample 1 size.
n2	Sample 2 size.
	Significance level.
_Pooled?	Check this option to pool samples based on their standard deviations.

Results

Result	**Description**
Test T	T-Test statistic.
Prob	Probability associated with the T-Test statistic.
Critical T	Boundary values of T associated with the α level that you supplied.

Confidence intervals

The confidence interval calculations that the HP 39G/40G/40G can perform are based on the Normal Z-distribution or Student's t-distribution.

One-Sample Z-Interval

Menu name Z–INT: 1 μ

This option uses the Normal Z-distribution to calculate a confidence interval for μ, the true mean of a population, when the true population standard deviation, σ, is known.

Inputs

Field name	Definition
$\bar{x}$ 1	Sample mean.
σ	Population standard deviation.
n	Sample size.
C	Confidence level.

Results

Result	Description
Critical Z	Critical value for Z.
μ min	Lower bound for μ.
μ max	Upper bound for μ.

Two-Sample Z-Interval

Menu name Z–INT: μ1– μ2

This option uses the Normal Z-distribution to calculate a confidence interval for the difference in the means of two populations, $\mu_1 - \mu_2$, when the population standard deviations, σ_1 and σ_2 are known.

Inputs

Field name	Defintion
$\bar{x}$ 1	Sample 1 mean.
$\bar{x}$ 2	Sample 2 mean.

Field name	Defintion
σ1	Population 1 standard deviation.
σ2	Population 2 standard deviation.
n1	Sample 1 size.
n2	Sample 2 size.
C	Confidence level.

Results

Result	Description
Critical Z	Critical value for Z.
Δ µ Min	Lower bound for $\mu_1 - \mu_2$
Δ µ Max	Upper bound for $\mu_1 - \mu_2$

One-Proportion Z-Interval

Menu name

Z–INT: 1 P

This option uses the Normal Z-distribution to calculate a confidence interval for the proportion of successes in a population for the case in which a sample of size, *n*, has a number of successes, *x*.

Inputs

Field name	Definition
x	Sample success count.
n	Sample size.
C	Confidence level.

Results

Result	Description
Critical Z	Critical value for Z.

Result	Description
π Min	Lower bound for π.
π Max	Upper bound for π.

Two-Proportion Z-Interval

Menu name

Z–INT: P1 – P2

This option uses the Normal Z-distribution to calculate a confidence interval for the difference in the proportions of successes in two populations.

Inputs

Field name	Definition
x1	Sample 1 success count.
x2	Sample 2 success count.
n1	Sample 1 size.
n2	Sample 2 size.
C	Confidence level.

Results

Result	Description
Critical Z	Critical value for Z.
$\Delta\,\pi$ Min	Lower bound for the difference in proportions of successes.
$\Delta\,\pi$ Max	Upper bound for the difference in proportions of successes.

One-Sample T-Interval

Menu name

T–INT: 1 μ

This option uses the Student's t-distribution to calculate a confidence interval for μ, the true mean of a population, for the case in which the true population standard deviation, σ, is unknown.

Inputs

Field name	Defintion
$\bar{x}$ 1	Sample mean.
Sx	Sample standard deviation.
n	Sample size.
C	Confidence level.

Results

Result	Description
Critical T	Critical value for T.
μ Min	Lower bound for μ.
μ Max	Upper bound for μ.

Two-Sample T-Interval

Menu name

T–INT: μ1 – μ2

This option uses the Student's t-distribution to calculate a confidence interval for the difference in the means of two populations, $\mu_1 - \mu_2$, when the population standard deviations, σ_1 and σ_2, are unknown.

Inputs

Field name	Definition
$\bar{x}$ 1	Sample 1 mean.
$\bar{x}$ 2	Sample 2 mean.
s1	Sample 1 standard deviation.
s2	Sample 2 standard deviation.
n1	Sample 1 size.
n2	Sample 2 size.

Field name	Definition
C	Confidence level.
_Pooled	Whether or not to pool the samples based on their standard deviations.

Results

Result	Description
Critical T	Critical value for T.
$\Delta\mu$ Min	Lower bound for $\mu_1 - \mu_2$.
$\Delta\mu$ Max	Upper bound for $\mu_1 - \mu_2$.