- prgmINVT
- df=18
- P(T≤t)=0.95

A percentile of 1.734 is returned.

Graphing The Chi–Square Distribution. To graph the chi–square distribution with 4 degrees of freedom and shade between 0 and 3.9, type

- WINDOW 0 15 1 -0.1 0.3 0.1
- Y = 2nd DISTR 6:χ^2pdf(X , 4) GRAPH
- 2nd DISTR DRAW 3:Shadeχ^2(0 , 3.9 , 4) ENTER

Probability For Chi–Square Distribution. To determine the probability the chi–square distribution is between 1.23 and 2.31 at 18 degrees of freedom, type

- 7:χ^2cdf(
- 2nd DISTR 1.23 , 2.31 , 18) ENTER

A probability of 0.000003565 is returned.

Percentile For Chi–Square Distribution. To run the INVCHI2 program to determine the 95th percentile of the Chi–Square distribution at 5 degrees of freedom, first type in PRGM INVCHI2 ENTER and then:

- prgmINVCHI2
- df=5
- P($\chi \leq \chi^2$)=0.95

A percentile of 11.07 is returned.

Graphing The F Distribution. To graph the F distribution with (4,5) degrees of freedom and shade between 2 and 3, type

- WINDOW 0 8 1 -0.2 0.7 0.1
- Y = 2nd DISTR 8:Fpdf(X , 4 , 5) GRAPH
- 2nd DISTR DRAW 3:ShadeF(2 , 3 , 4 , 5) ENTER

Probability For F Distribution. To determine the probability the F distribution is between 1.23 and 2.31 at 18, 3 degrees of freedom, type

- 2nd DISTR 1.23, 2.31, 18, 3) ENTER

A probability of 0.2287... is returned.

Percentile For F Distribution. To run the INVF program to determine the 95th percentile of the Chi–Square distribution at 5, 8 degrees of freedom, type

- prgmINVF
- df1=5
- df2=8
- P($R \leq t$)=0.95

A percentile of 3.687... is returned.

Random Number Generator. To generate 20 numbers chosen at random from between 0 and 99, we must first store seed 7 in the random number generator. This essentially changes the "pointer" in the TI–83 to a different location in the random number list stored in the calculator. When everyone in the lab puts in seed 7, all calculators will generate the *same* sequence of random numbers. On the quiz or homework, a seed will be specified, so that everyone in the class uses the same random number sequence and so generates the same sampling distribution.

7 STO $\rightarrow$ MATH PRB rand ENTER

The number 7 is returned.

The twenty random numbers between 0 and 99 are generated as follows:

MATH PRB randInt($0, 99, 20$) ENTER

The following sequence of random integer values is returned:

$$21, 99, 57, 28, 80, 59, 56, 35, 89, 85, 54, 64, 82, 41, 2, 49, 66, 41, 64, 67.$$

Simulating Sampling Distributions. Consider the following costs of 3 CDs bought at the "Great CD Store", along with their probability of purchase:

x	\$14	\$15	\$16
$P(X = x)$	0.1	0.3	0.6

Determine the sampling distribution of mean cost, $\bar{X}$, of *two* CDs (sampling with replacement and order matters) using 10 repetitions/simulations and seed 7 and the following procedure,

if random number	01,...,10	11,...,40	41,...,99,00
then "count" CD cost	\$14	\$15	\$16

to collect 10 *pairs* of costs (*twenty* numbers in all).

We must first store seed 7 in the random number generator[2]:

$$7 \text{ STO} \rightarrow \text{ MATH PRB rand ENTER}$$

The number 7 is returned.

The twenty random numbers between 0 and 99 are generated as follows:

$$\text{MATH PRB randInt(} 0, 99, 20) \text{ ENTER}$$

The following sequence of random integer values is returned:

$$21, 99, 57, 28, 80, 59, 56, 35, 89, 85, 54, 64, 82, 41, 2, 49, 66, 41, 64, 67.$$

Using the sampling procedure, since 21 corresponds to choosing the second CD with cost \$15 and 99 corresponds to choosing the third CD with cost \$16, the average of these two CDs is $\frac{15+16}{2} = \$15.5$. In a similar way, the approximate sampling distribution is constructed as given below:

first CD	\$15	\$16	\$16	\$16	\$16	\$16	\$16	\$14	\$16	\$16
second CD	\$16	\$15	\$16	\$15	\$16	\$16	\$16	\$16	\$16	\$16
mean cost	\$15.5	\$15.5	\$16	\$15.5	\$16	\$16	\$16	\$15	\$16	\$16

and so,

mean cost	\$14	\$14.5	\$15	\$15.5	\$16
proportion (out of 10)	$\frac{0}{10}$	$\frac{0}{10}$	$\frac{1}{10}$	$\frac{3}{10}$	$\frac{6}{10}$

Confidence Intervals For Mean μ, Small Sample. In a study to determine the effects of nitrates as meat preservatives, 15 data values, given in "nitrate.dat" above, are observed. Assuming the underlying distribution is normal, determine both a 90% and 95% CI for the mean effect of nitrates, μ.

In this case, the data values must first be stored in one of the STAT lists, say list L_1:

[2]This essentially changes the "pointer" in the TI–83 to a different location in the random number list stored in the calculator. When everyone in the lab puts in seed 7, all calculators will generate the *same* sequence of random numbers. On the quiz or homework, a seed will be specified, so that everyone in the class uses the same random number sequence and so generates the same sampling distribution

- STAT ENTER 7251 ENTER $\cdots$ 8724 ENTER

Then, a 90% CI ("t–interval") is given by:

- STAT TESTS 8
- DATA ENTER ∇ 2nd L_1 ∇ 1 ∇ 0.90 ∇ ENTER

After some effort, the pair of numbers, $(7332.9, 8244.7)$, which are the upper and lower limits of the 90% CI, is returned.

Then, a 95% CI ("t–interval") is given by:

- STAT TESTS 8
- DATA ENTER ∇ 2nd L_1 ∇ 1 ∇ 0.90 ∇ ENTER

The pair of numbers, $(7233.7, 8343.9)$, which are the upper and lower limits of the 95% CI, is returned.

Test For Mean μ, Small Sample. In a study of the times of first sprinkler activation (in seconds) for a series of tests of fire–prevention sprinkler systems, 13 data values, given in "activation.dat" above, are observed. The system has been designed so that the true average activation time is supposed to be at most 25 seconds. Assume the underlying distribution is normal.

In this case, the data values must first be stored in one of the STAT lists, say list L_1:

- STAT ENTER 27 ENTER $\cdots$ 24 ENTER

Then, the p–value for this "t–test" is given by:

- STAT TESTS 2
- DATA ∇ 25 ∇ L_1 ∇ $> \mu_o$ ENTER ∇ CALCULATE ENTER

The p–value 0.0426 is returned.

Confidence Interval For Difference in Means $\mu_1 - \mu_2$, Independent Samples. Hematocrit level[3] is a measure of the concentration of red cells in blood. The hematocrit levels for a random sample of nine 17–year–old males and six 17–year–old females is given by:

males	3.06	2.78	2.87	3.52	3.81	3.60	3.30	2.77	3.62
females	1.31	1.17	1.72	1.20	1.55	1.53			

[3]Samuels, related to Example 7.1, p 190 and Example 7.3, p 193, 1989.

In this case, the data values must first be stored in two of the STAT lists, say list L_1 and L_2.

A *pooled* 95% confidence interval of the difference in means, $\mu_1 - \mu_2$, is given by, is given by:

- STAT TESTS 0:2–SampTInt...
- DATA ENTER Data ∇ 2nd L_1 ∇ 2nd L_2 ∇ 1 ∇ 1 ∇ 0.95 ∇ Yes ∇ ENTER

After some effort, the pair of numbers, $(1.4562, 2.2351)$, which are the upper and lower limits of the pooled 95% CI, is returned.

An *un*pooled 95% confidence interval of the difference in means, $\mu_1 - \mu_2$, is given as before, only, this time, answer "no" to the question, "Pooled?". In this case, the pair of numbers, $(1.4976, 2.1935)$, which are the upper and lower limits of the *un*pooled 95% CI, is returned.

Test For Difference in Means $\mu_1 - \mu_2$, Independent Samples. Hematocrit level[4] is a measure of the concentration of red cells in blood. The hematocrit levels for a random sample of nine 17–year–old males and six 17–year–old females is given by:

males	3.06	2.78	2.87	3.52	3.81	3.60	3.30	2.77	3.62
females	1.31	1.17	1.72	1.20	1.55	1.53			

In this case, the data values must first be stored in two of the STAT lists, say list L_1 and L_2.

A *pooled* two–sided test $\mu_1 - \mu_2 \neq 0$ is given by, is given by:

- STAT TESTS 4:2–SampleTTest
- DATA ENTER Data ∇ 2nd L_1 ∇ 2nd L_2 ∇ 1 ∇ 1 ∇ $\mu_1 \neq \mu_2$ ∇ Yes ∇ ENTER

The p–value 0.000000042 is returned.

Test For Difference in Means $\mu_d = \mu_1 - \mu_2$, Dependent Samples. First get the calculator to determine the differences in the paired data and then perform either a "t–test", or, if $n > 30$, a "z–test".

Test For Variance σ^2. (9.108, p 483, Johnson) The standard deviation of the time of maturity of a random sample of 30 plants of a new hybrid strain of green beans is found to be 1.65 days. Under a null of 2.1 days, the p–value is given by:

- 2nd DISTR 7:χ^2cdf 0 , (30-1)$1.65^2/2.1^2$, 29) ENTER

[4]Samuels, related to Example 7.1, p 190 and Example 7.3, p 193, 1989.

The p–value 0.0538 is returned.

Test of $\frac{\sigma_1}{\sigma_2}$. Does the "plasma" data support the claim that $\sigma_1^2 > \sigma_2^2$ at $\alpha = 0.05$?

- *One Way.*
  - 2nd DISTR 9:Fcdf(.16/.13 , E99, 8 , 5) ENTER

  The p–value of 0.42... is returned.

- *Another Way.*
  - STAT TESTS D:2–SampFTest... ENTER
  - Stats ENTER $\sqrt{0.16}$ 9 $\sqrt{0.13}$ 6 $> \sigma_2$ Calculate ENTER

  The p–value of 0.42... is returned.