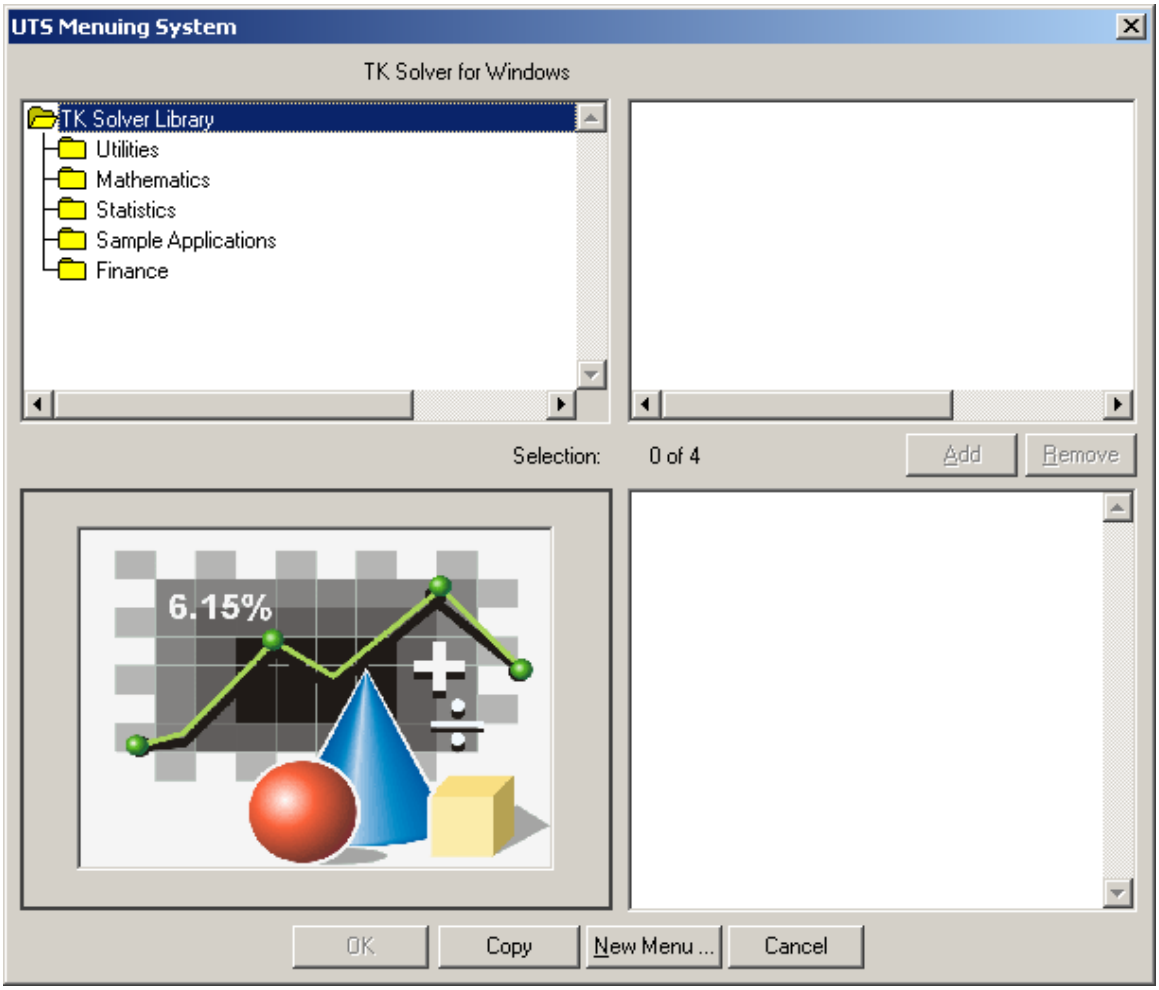
The TK Solver Library



The TK Library is accessed via the Applications Menu. It is a collection of TK files. Some of the files contain a single user-defined function. Some contain just unit conversions. These simple files are generally classified as tools. Some of the files contain complete examples, with many objects of all types. Or in the case of many the statistics files, there may be many functions merged together to solve a particular problem such as for curve-fitting. These are sometimes referred to as applications. Tools are intended to be merged into your models while Examples and Applications are intended to be used on their own and could cause confusion if merged into another file.

Let's look at examples of each of the three types of Library files.

Use the Library Menu to go to Utilities – List Manipulation – Tools and load the first tool there, reverse. A single function appears on the function sheet.

Name	Type	Arguments	Comment
reverse	Procedure	1;0	Reversing the order of elements in a list

It is a procedure function, processing a single input. Open the subsheet to see the algorithm.

Statement
; Description: The function reverses the order of elements in a list.
; Notation: L name of the list to be reversed
n:= length(L)
n1:= n + 1
if n>count(L) goto blanks
for i=1 to n/2 ; good for lists without blanks
j:= n1 - i
(L[i],L[j]):= (L[j],L[i])
next i
return
blanks:
for i=1 to n/2 ; an alternative treatment of lists with blanks
j:= n1 - i
tempi:= elt(L,i,'blank)
tempj:= elt(L,j,'blank)
if tempi='blank then call blank(L,j) else L[j]:= tempi
if tempj='blank then call blank(L,i) else L[i]:= tempj
next i

The procedure includes comments to help us understand its use. We can see that it requires the name of the list to be reversed as the only input. Create a small list on the list sheet and call the function to try it.

Let's try another example. Open the Library Menu again and go to Statistics – Distributions and Random Numbers and load the Normal selection. Several functions appear on the function sheet.

Name	Type	Arguments	Comment
normPDF	Rule	3;1	Normal distribution, PDF
normCDF	Rule	3;1	Normal distribution, CDF
inormCDF	Rule	3;1	Normal distribution, Inverse CDF

Open the second one, normCDF, and observe the rules within.

Rule
; Notation: x independent variable
; m mean
; sd standard deviation
; CDF Cumulative Density; probability of observing a value <= x.
CDF = (1+erf((x-m)/sd/sqrt(2)))/2

There are four lines of comments and just a single equation. We see that the function requires three inputs and returns one output. Enter a rule on the rule sheet to reference this function and try solving it with some sample values.

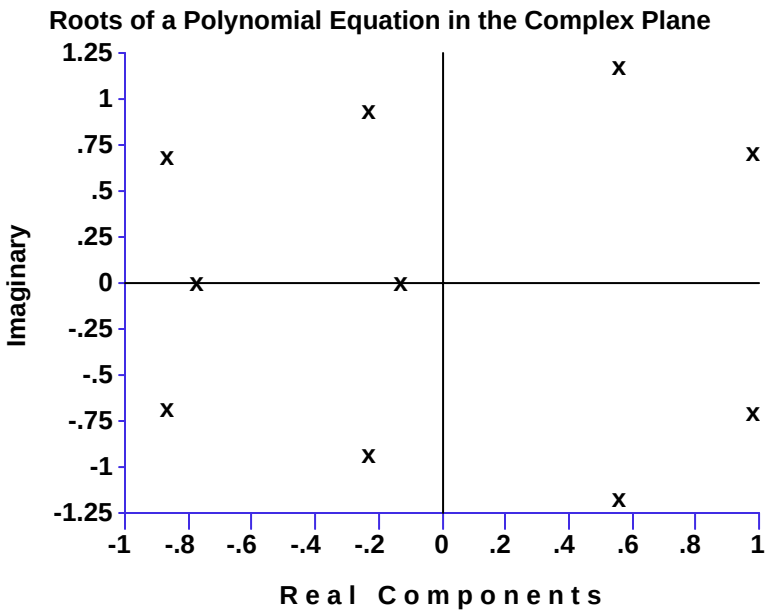
Alternatively, you can use TK's Examine Command to process the function without entering a rule. Try that too.

Next, we'll look at some examples from the Library. Open the Library Menu and go to Mathematics – Roots of Equations – Examples and select Polynomial Equations.

When the example loads, we see a rule sheet with comments and a single function call, along with a table in the lower portion of the screen with sample coefficients for a 10^{th} order polynomial. The Bairstow function could be loaded independently as a tool but this example shows it in action. Solve and observe the updated table with the ten roots of the polynomial.

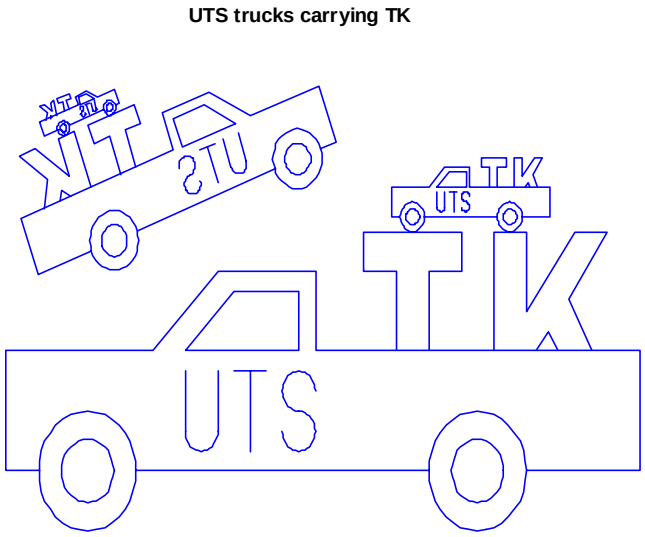
Element	Coeff	Roots:	Re	Im
1	.32432		-.13119217	0
2	.00565		-.7710957	0
3	.27196		-.2298646	.934845084
4	.37294		-.2298646	-.93484508
5	.60025		-.86702428	.689535261
6	.17577		-.86702428	-.68953526
7	.58748		.557944363	1.17374496
8	.64068		.557944363	-1.173745
9	.91559		.98137792	.704417983
10	.81142		.98137792	-.70441798
11	.09197			

Checking the Object Bar, we see that there is also a plot of the solutions in the complex plane.



Many of the tools in the TK Library are illustrated by examples like this one.

For another example, use the Library Menu to go to Utilites – Graphics Utilities – Examples and select General purpose graphics. When the file loads, we see a Comment Sheet describing how to use the functions (tools) featured in the Example. Solve the model and view the plots.



Let’s check the function sheet to see all the tools in this example.

Name	Type	Arguments	Comment
ASPECT	Procedure	3;0	scaling x coordinates
masterC	Procedure	2;0	Master graph generator, calibrate circle
masterT	Procedure	2;0	Master graph generator, truck
mastermasterT	Rule	0;0	Composite truck
body	List	1;1	truck body
window	List	1;1	truck window
TK	List	1;1	TK on truck
erase	Procedure	2;0	slate eraser
vector	Procedure	4;0	vector generator
line	Procedure	6;0	line generator
box	Procedure	6;0	box generator
circle	Procedure	7;0	circle generator
ellipse	Procedure	8;0	ellipse generator
scale	Procedure	4;0	picture scaling
mirror	Procedure	1;0	mirroring
translate	Procedure	4;0	parallel translation
rotate	Procedure	5;0	rotation
append	Procedure	4;0	merging two pictures

Some of the functions are specific to the example and some are generic tools used for generating and processing data points. Let’s take a look at the rotate function.

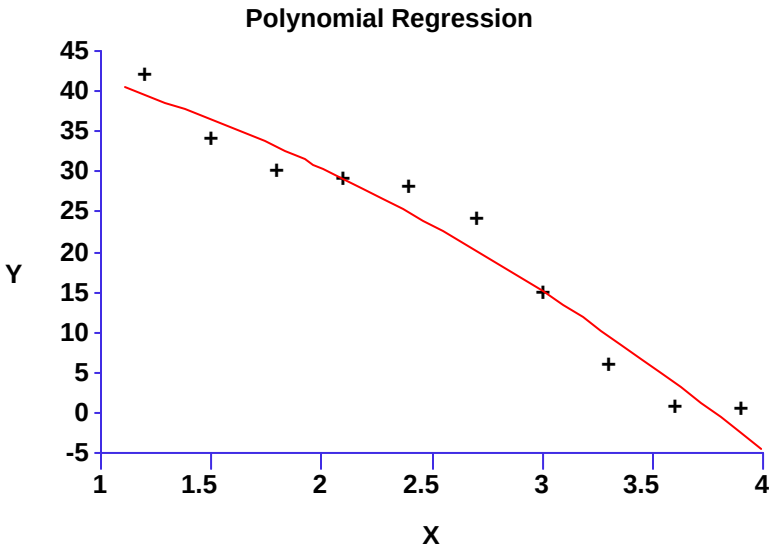
```
Statement
; Notation:  x,y    names of lists of the picture coordinates
;           x0,y0  center of rotation
;           phi    angle of rotation (in degrees)

; Description: Transforms the picture coordinates by rotating them around
;             a given point

sin:= sind(phi)
cos:= cosd(phi)
for i=1 to length(x)
   X:= elt(x,i,'blank)
   if X='blank goto next
      X:= X - x0
      Y:= y[i] - y0
      x[i]:= X*cos - Y*sin + x0
      y[i]:= X*sin + Y*cos + y0
next: next i
```

The function requires five inputs as described by the comments. The coordinates are assumed to be in two lists. The function updates those lists.

Now let's look at an application from the TK Library. Go to Statistics – Curve Fitting and select Polynomial Regression. The application loads with comments to help get you started. There is also a table with sample data set up to solve for the best fitting 2nd order polynomial. Solve and the table fills.

Element	X	Y	residuals	SUMMARY	STATS
1	1.2	42	+2.355E0	order	2
2	1.5	34	-2.525E0	N	10
3	1.8	30	-3.015E0	Syx	3.30976647
4	2.1	29	-1.155E-1	adj R2	.948171138
5	2.4	28	+3.173E0	p	.000104221
6	2.7	24	+3.852E0		
7	3	15	-8.091E-2	b0	48.2339394
8	3.3	6	-3.624E0	b1	-4.5611111
9	3.6	.8	-2.978E0	b2	-2.1632997
10	3.9	.5	+2.958E0	b3	0
11				b4	0
12				b5	0
13				b6	0
14				b7	0
15				b8	0

There are also plots. Here is the plot of the data with the polynomial curve.



Try changing to a 4th order polynomial and observe the changes.