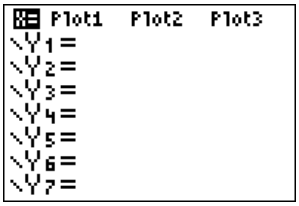
Inequality Graphing

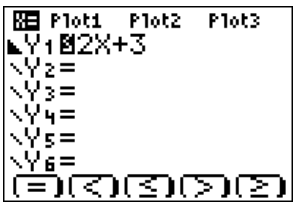
CATEGORY
Graphing mode

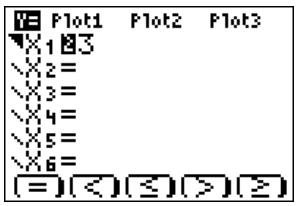
DESCRIPTION
Inequality Graphing enables the user to enter inequalities using symbols, even inequalities involving vertical lines in an `X=` editor. It is possible to plot the inequalities, including union and intersection shades, and to store the intersection points between the corresponding functions.

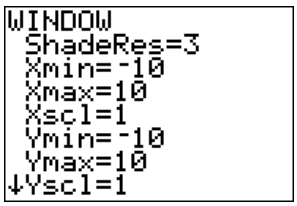
DIDACTICAL SUGGESTIONS
With this application it is possible to add very easily a graphical approach to solving systems of linear equations (two variables) and linear programming.

Inequality Graphing is an application that once it is started it keeps running in the background. It changes the `Y=` window as follows and adds an `X=` editor to it. It also adds a shade resolution item (`ShadeRes`) to the `WINDOW` settings.

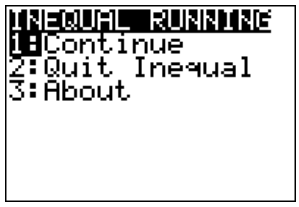








To quit Inequality Graphing you need to activate it again in the `APPS` menu and then select `2: Quit Inequal`. Note that it is not possible to run Inequality Graphing and Transformation Graphing (3.14) at the same time.

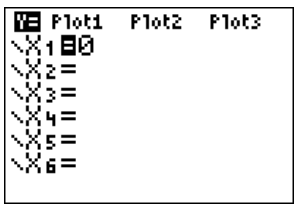


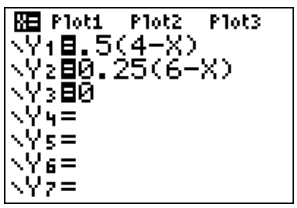
The following two examples will show how Inequality Graphing works.

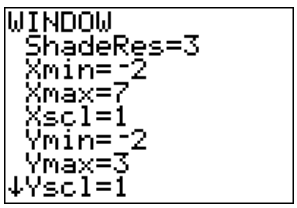
Example 1
We will determine the region of points (x, y) that satisfy:

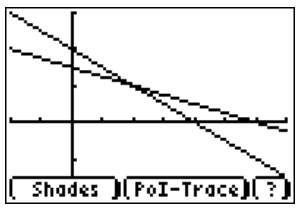
$$\begin{cases} x+2y \le 4 \\ x+4y \le 6 \end{cases} \text{ and } \begin{cases} x \ge 0 \\ y \ge 0 \end{cases}.$$

Therefore we define the linear functions `Y1=0.5(4-X)`, `Y2=0.25(6-X)`, `Y3=0`, `X1=0` and plot them with the following WINDOW-settings (press `TRACE CLEAR` to remove the menu at the bottom of the screen).





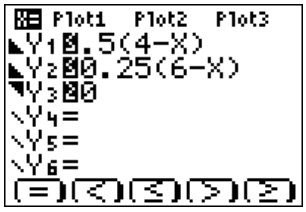


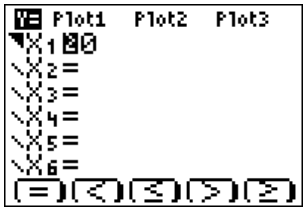


All the points in the enclosed area are solutions to our problem. It is possible to shade this area and to calculate its vertices.

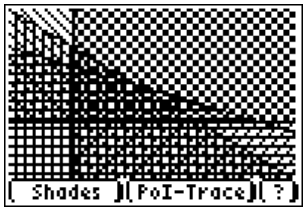
To shade this area put the cursor on the equality signs to change them as follows into inequalities:

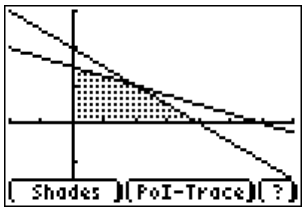
[ALPHA]F1 → =
[ALPHA]F2 → <
[ALPHA]F3 → ≤
[ALPHA]F4 → ≥
[ALPHA]F5 → >





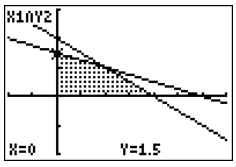
Press GRAPH, select Shades ([ALPHA]F1) and 1: Ineq Intersection.

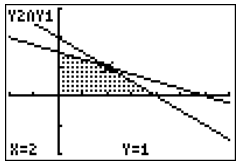


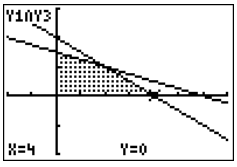


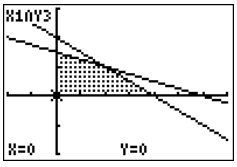
For linear inequalities it is possible to calculate the vertices the shaded area with PoI-Trace ([ALPHA]F3): ◀ ▶ = change the second function & ▲ ▼ = change the first function.

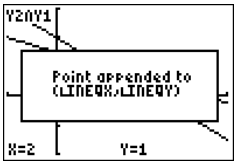
You can store a selected vertex by pressing STO▶. The coordinates of the vertex will automatically be stored in the lists INEQX and INEQY.





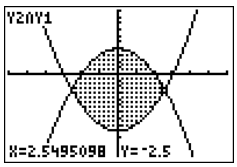


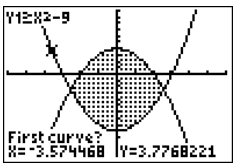


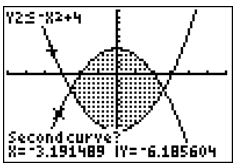


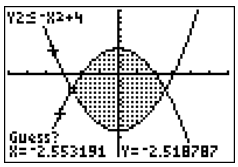
Example 2

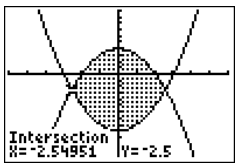
Let's try to find the area between the functions $f(x) = x^2 - 9$ and $g(x) = -x^2 + 4$. For non linear functions it is not always possible to find the intersection points through Inequality Graphing. In such a case we need to use 5: intersect of the graphical CALC menu.





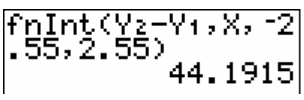






To approximate the area we can use the fnInt command. The calculations above are also numerical approximations of the intersection points $x_1 = -\sqrt{\frac{13}{2}} \approx -2.55$ and $x_2 = \sqrt{\frac{13}{2}} \approx 2.55$.

$\int_{-2.55}^{2.55} \big(g(x) - f(x)\big)\,dx$ is a good approximation of this area.



POINT OF VIEW

Inequality Graphing is a very good graphical extension. It helps students to visualize the solution of a system of equations and to find the area of the enclosed region by means of functions without doing a lot of calculations.