How to solve for a value numerically when you have an equation with one unknown, but you can't rearrange the equation to solve for the unknown. You can solve with optimization or iteration or graphically.

For example, if $x^2 + \sin(x) = 5\sqrt{(1 + \exp(x))}$, you probably can't solve for x. However, you can write $f(x) = x^2 + \sin(x) - 5\sqrt{(1 + \exp(x))} = 0$. Then, you can try to find x to make $f(x) = 0$. function. There may be more than one solution, of course, in which case you will need to ask which one(s) makes sense physically for the problem.

Iteration: Spreadsheet method: enter some value of x in one entry of a spread sheet, and then define f(x) in another entry. Then change the value of x until f(x) is 0. In this case, we can put x in C2 and then write =C2^2+SIN(C2)-5*SQRT(1+EXP(C2)) in another entry. I change x by hand until I get x = -2.42374, and f(x) = 2.8E-5.

Minimiziation MATLAB method: We can use fminsearch to minimize $\left(f(x)\right)^2$. The reason we minimize the square is so it will always be nonnegative, so the minimum is zero rather than a really big negative number. I then define a function "obj" (or whatever you want to name it) that returns the value to be minimized, which I usually call "J" Then, I call fminsearch and tell it to use a guessed value of x to and the function "obj". Fminsearch iteratively calls obj to find J, then changes x, and does it again. It is doing the same thing you would with a spreadsheet, to see how J changed for some change in x. Thus I write the function below, with an embedded function. all in one matlab m-file:

```
% WendyMinExample
function WendyMinExample
guesses = 4; % random guess for what we are solving.
estimates = fminsearch(@obj,guesses)

function J = obj(x)
f = x^2+sin(x)-5*sqrt(1+exp(x));
J = f^2;
```

When I call the function above, I get

```
estimates =
   -2.4237
```

Graphical method (spreadsheet or MATLAB, etc). On one graph, plot $y_1 = x^2 + \sin(x)$ and $y_2 = 5\sqrt{(1 + \exp(x))}$. Find where they intersect. The x-value is what is important, not the y1 or y2. You can see they cross around -2.4