Solver is a Microsoft Excel function that helps you find a solution to a particular calculation, given specified constraints. The elements of a Solver problem:

1. **The objective**. Solver focuses on the objective, which involves a key calculation. This calculation may be a summation, a product, a valuation, etc., that is dependent on other cells. The objective may be to maximize or minimize the key value, or for the key value to be equal to some specified value.
2. **The independent inputs**. These are values external to the problem.
3. **The decision cells**. These cells, when combined with the independent cells, are involved in the key calculation.
4. **Any constraints**.

Solver is part of with Microsoft Excel and you can find it in the Data ribbon. If you do not see Solver, go to Excel Options > Add-ins, and then select Solver from the list if Excel Add-ins.

As an example, suppose you have a number of capital projects, with their initial investment and net present value, and you have a limit on the capital budget. You can use Solver to solve for the set of projects that maximize the total net present value within this budget.
Step 1:  Set up the independent cells
In our example, the independent cells are the initial investment and the present value of the future cash flows. If we subtract the initial investment from the present value, we arrive at the net present value:

![Table showing available projects with initial investment, present value of future cash inflows, and net present value (NPV).]

Step 2:  Set up the decision cells
Our objective is to maximize the total net present value of selected projects. We create another variable, “Accept?”, which is a dummy variable: taking on a value of 1 if accepted, 0 if not accepted. We begin with the variable Accept?, with zero values for each project – but this will change once we solve for the optimal set of projects.
Step 3: Set up the key calculation
We now need to set up the calculations for two elements:

- The total spent, which will be constrained to the budget
- The total net present value, which is what we want solver to maximize within the constrained budget.

The easiest way to accomplish this is to use the SUMPRODUCT function. SUMPRODUCT calculates the sum of the product of the specified arrays, which in this case are the expenditures and the Accept? binary; in other words, what is summed depends on whether it is accepted.

Therefore, for example, for the total expenditure,
And for the total net present value:

In other words, using SUMPRODUCT will add only those net present values for accepted (Accept?=1) projects.
Before we apply solver, this does not look very interesting.

Step 4: Apply Solver
Use the Data ribbon, and select Solver. Once you select Solver, the Solver Parameters box will appear:

![Solver Parameters](image)

Parameters:
- The target cell in this example is D21, which is the SUMPRODUCT of the NPV column and the Accept? column, and our goal is to maximize the total net present value.
- The independent values are the inputs (Initial investment and Present value of future cash flows), and the calculated input,
- The decision cells, “By Changing Cells”, are the cells in the Accept? column.
- The constraints are the following:
  - The SUMPRODUCT of the Initial Investment and the Accept? is less than the capital budget.
  - The Accept? cells are binary (that is, 0 or 1).
When or if this converges, you will get a status box. The successful convergence for this problem is:

If Solver cannot converge upon a solution, you will be notified of this. You can then decide to either change the options on the convergence (that is, allow more time or iterations), or alter the constraints (if necessary).

In our example, the result are:
In other words, we should accept projects A, B, C, H, and L. This produces a net present value of $380,000 on the $4 million of expenditures.

If we change the budget to $3 million, we arrive at a solution of accepting projects A, B, C, D, E, F, G, L and M:

![Solver Parameters](image)

we arrive at a solution of accepting projects A, B, C, D, E, F, G, L and M:
Refinements
What we just performed is a simply Solver problem. More complex problems can have several decision variables involved, with many more constraints. Consider the following possible finance applications:

- Solve for the depreciation method that produces a specific earnings per share target.
- Solve for the multiple rates in an IRR problem.
- Solve for the cash needed/excess in a forecasting model.

In addition, you can:

- Use Formula > Name Manager to specify names for sets of cells.
- Make the worksheet dynamic.
- Save the Scenario (constraints and objective) for later use.
- Request that Excel show the iteration steps [Options > Show Iteration Results]