

Özyeğin University

EE303 Fundamentals of Power Systems

FINAL PROJECT REPORT

How to use this program:

The user should enter the cost equations and min-max power limits of 3 generators. Then the user will select the power demand from the slider just after clicking the “SET BOUNDARIES” button. That button determines the minimum and maximum power demand by summing up the generator’s boundaries. After clicking the button the user will be able to select the total demand of the system by sliding the slider. While sliding the slider, demand will be shown instantly.

STEP 1 – Entering the cost coefficients

The screenshot displays the EE303 program interface with four main sections and four instructional steps:

- STEP 1 – Entering the cost coefficients:** This section, titled "Cost Equations - Step 1", contains three cost equations for three generators. Each equation is of the form $\text{Cost Gen } i = a + b P_i + c P_i^2$. The values entered are: Gen 1 (a=5, b=10, c=0.016), Gen 2 (a=4, b=12, c=0.018), and Gen 3 (a=3, b=8, c=0.02). This section is circled in red.
- STEP 2 – Entering the limits:** This section, titled "Demand Setter - Step 2", shows power limits for each generator: $50 \leq P_1 \leq 100$ MW, $150 \leq P_2 \leq 200$ MW, and $50 \leq P_3 \leq 200$ MW. This section is also circled in red.
- STEP 3 – HIT “SET BOUNDARIES”:** A red arrow points to the "SET BOUNDARIES" button, which is located to the right of the power limits section.
- STEP 4 – Determine the total demand by sliding:** A red arrow points to a slider control. The slider is currently set to 400, and the text "Demand : 400" is displayed below it.
- Outputs & Incremental Cost:** This section at the bottom left shows the results of the simulation. It includes labels for "Power output of Generator 1 is :", "Power output of Generator 2 is :", "Power output of Generator 3 is :", and "Incremental Cost is :". A red arrow points to the "RUN" button, which is labeled "FINAL STEP – HIT THE “RUN” BUTTON".
- Buttons:** At the bottom, there are two buttons: "RUN" and "RESET".

Now the user can hit the “RUN” button to see the power outputs, incremental cost and the graphs. User can click to “RESET” button to delete the entered values and the results to type different equations and limits. If user only wants to change the boundaries, instead of clicking “RESET” button, just hitting the “SET BOUNDARIES” button will be enough after changing the boundary values, then click “RUN” again.

Purpose of this program:

The purpose of this program is determining the output power generated by 3 different generators to supply the specified demand in a way that will minimize the total cost of fuel. Each generator has a unique production cost defined by its fuel coefficients. This process is called Economic Dispatch. Economic dispatch is defined as the coordination of the production costs of all the participating units in supplying the total load. The purpose of economic dispatch is to determine the optimal power generation of the units participating in supplying the load. The sum of the total power generation should equal to the load demand at the station.

Economic Dispatch models the electric power system and dispatches the available generation resources to supply a given load for each control area in the most economic way in real-time operation. The objective is to minimize the total generation cost by meeting the system load demand and Lower and Upper power limits of each generator.

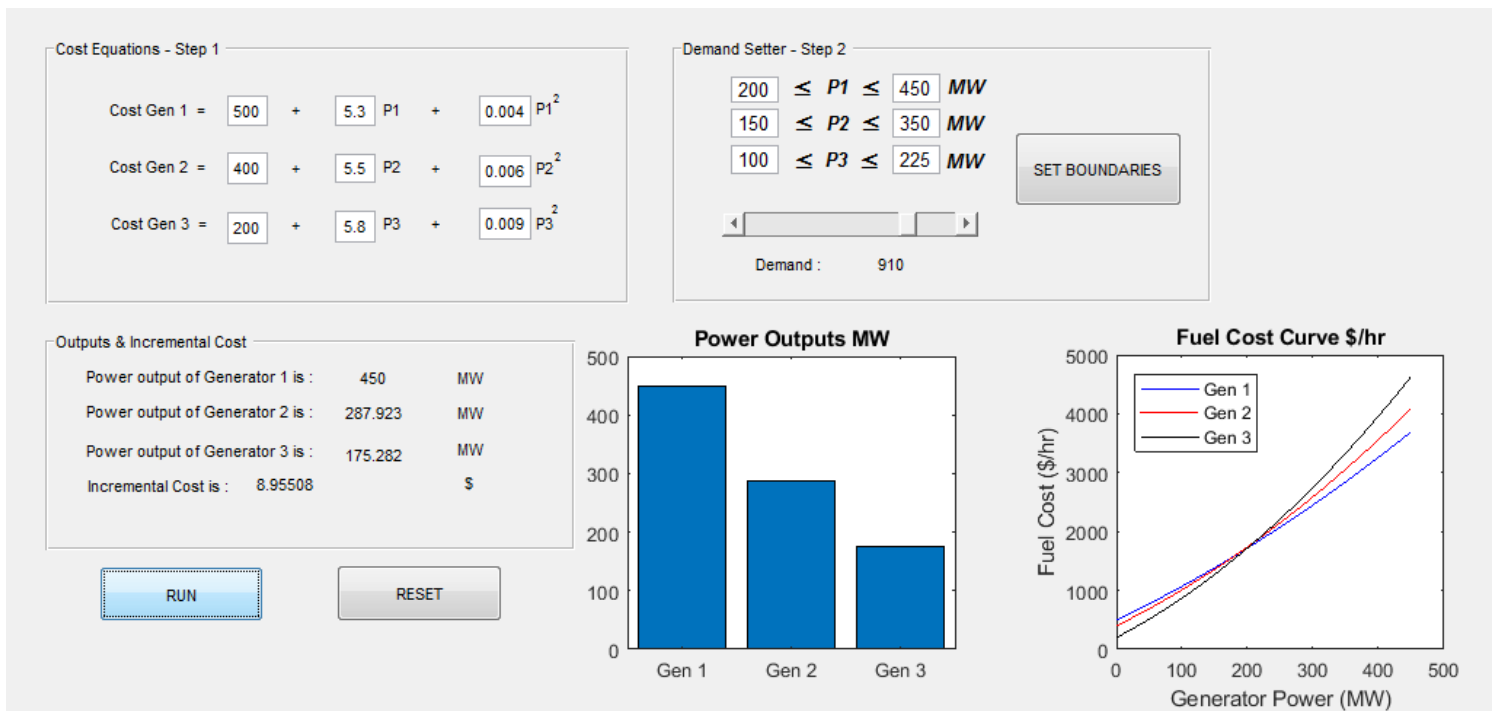
Method of this program :

How our program does this minimization as follows: First it defines a Lagrangian function which is a function of power supplies and λ . Then it takes the derivatives and sets these equal to zero for minimization purpose. After this step power supplies become functions of λ . Our program needs a perfect λ such that total power supply is equal to demand. For this reason the program estimates two λ s in a way that λ_{high} makes total power supply greater than demand and λ_{low} makes total power supply less than demand. Thus the perfect λ must be between λ_{high} and λ_{low} . Then the program defines λ_{middle} and checks according to λ_{middle} if the total power supply is greater than demand or not. If it is greater than demand then λ_{middle} becomes λ_{high} else λ_{middle} becomes λ_{low} and it iterates like that. After a reasonable number of iterations the gap between λ_{high} and λ_{low} becomes too small such that it satisfies our limit then the program terminates iterations and it assumes that perfect λ is λ_{middle} . Therefore the program eliminates an infinite iteration and it gets a good value of λ . Finally depending on the perfect λ the program calculates the total power supply in a way that total cost is minimum.

Sample Program 1



Sample Program 2



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