CEL LAB CASE STUDY 1

Market equilibrium price determination

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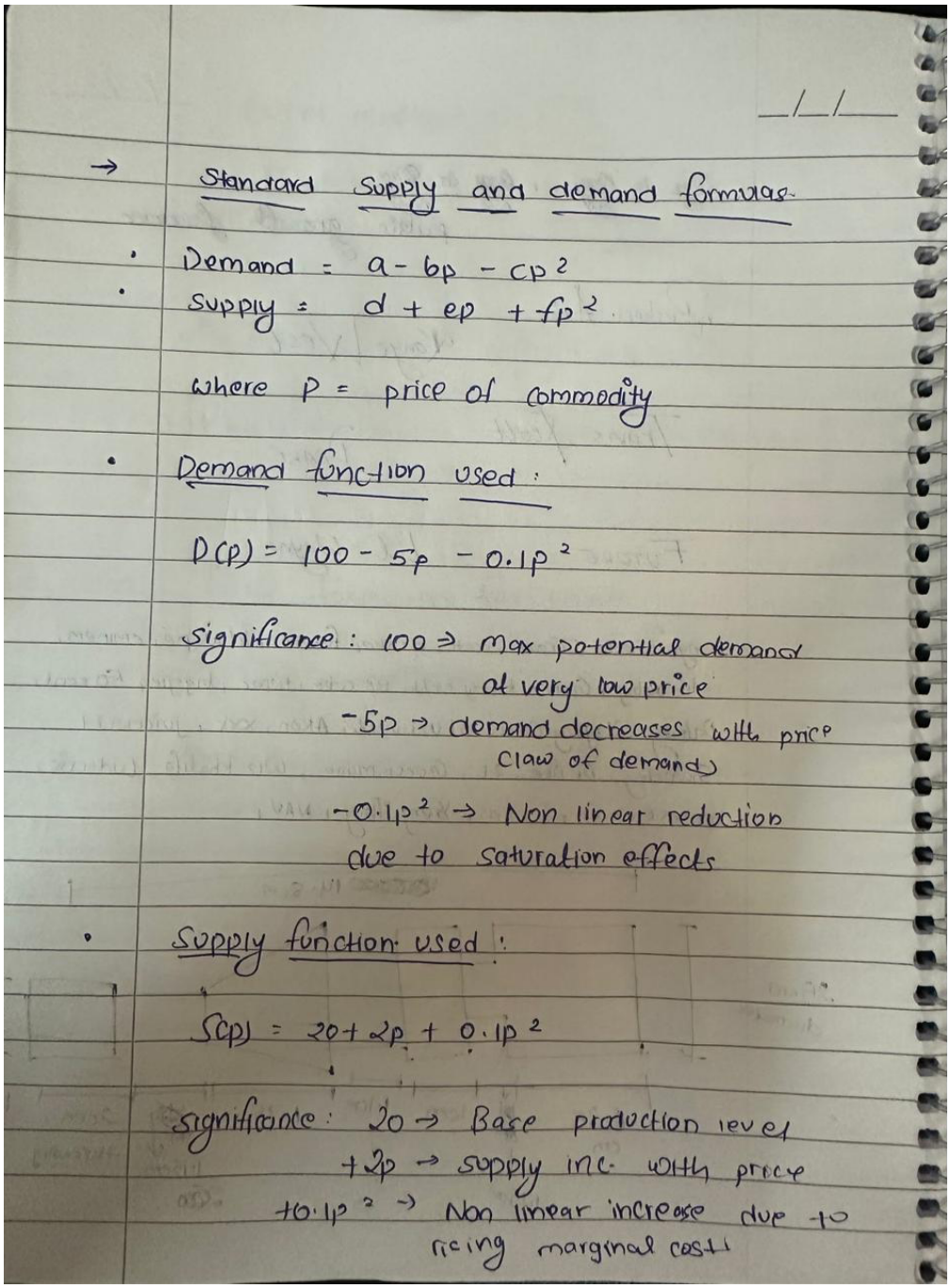
- DESCRIPTION

  Model demand and supply curves as nonlinear functions and compute equilibrium price numerically

Numerical Method:



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→ Standard supply and demand formulas

- Demand = $a - bp - cp^2$
- Supply = $d + ep + fp^2$

where p = price of commodity

- Demand function used :

$D(p) = 100 - 5p - 0.1p^2$

significance : 100 → max potential demand at very low price

$-5p$ → demand decreases with price (law of demand)

$-0.1p^2$ → Non linear reduction due to saturation effects

- Supply function used :

$S(p) = 20 + 2p + 0.1p^2$

significance : 20 → Base production level

$+2p$ → supply inc. with price

$+0.1p^2$ → Non linear increase due to rising marginal cost

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- **Market Equilibrium Condition.**

At equilibrium

$$D(p) = S(p)$$

$$\therefore \quad 100 - 5p - 0.1p^2 = 20 + 2p + 0.1p^2$$

Rearranging:

$$\boxed{0.2p^2 + 7p - 80 = 0}$$

- **Defining Imbalance (error)**

→ Error = $S(p) - D(p) = 0.2p^2 + 7p - 80$

Interpretation: $\varepsilon > 0$ → Excess supply

$\varepsilon < 0$ → exess demand

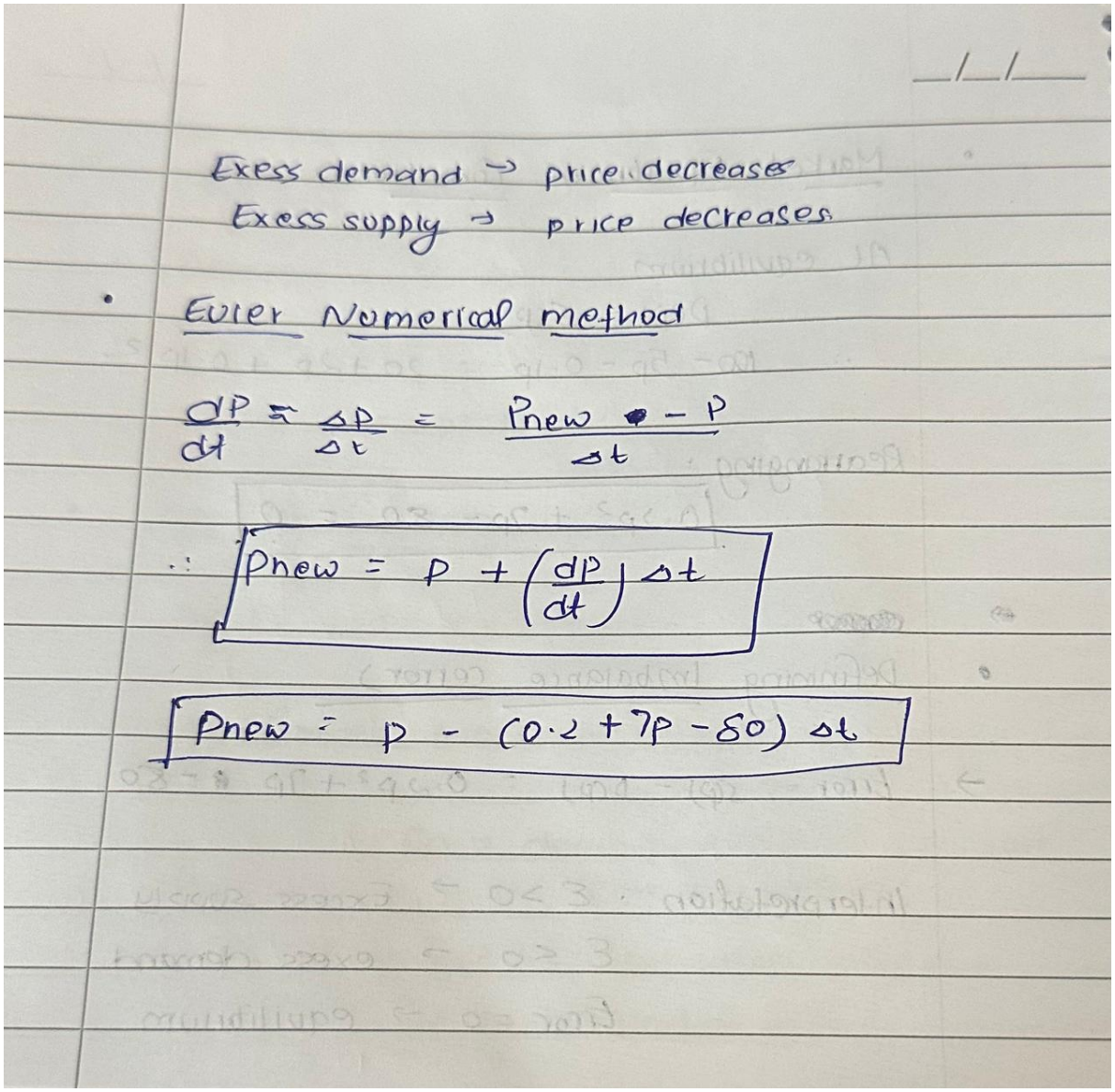
Error $= 0$ → equilibrium.

→ **To solve nomerically.**

$$\frac{dp}{dt} = -(\text{error})$$

$$\frac{dp}{dt} = -(0.2p^2 + 7p - 80)$$

"-ve sign is used" to ensure corrective behaviour.



Matlab Code

```
p = 50;
dt = 0.01;


P = p;


while true
    error = 0.2*p^2 + 7*p - 80;
    p_new = p - error*dt;

    P(end+1) = p_new;
```

```
    if abs(p_new - p) < 0.001
        break;
    end

    p = p_new;
end


fprintf('Equilibrium price = %.2f units\n', p_new);


p = 0:0.1:20;
D = 100 - 5*p - 0.1*p.^2;
S = 20 + 2*p + 0.1*p.^2;


plot(p,D,'b',p,S,'r')
xlabel('Price')
ylabel('Quantity')
legend('Demand','Supply')
grid on
```

Output And Graph