Constrained Optimization
- how to optimize a objective function subject to certain constraints

e.g. Farmer's fence.
Farmer get F feets of fence, and he could choose the width W and the length L, so how could she obtain largest area?

choice variables: L, W
constrain: $F \geq L+W$
objective function: $L \cdot W$

Formal problem:

$$\max \quad L \cdot W$$
$$L \geq 0$$
$$W \geq 0$$
$$\text{subject to} \quad L+W \leq F$$

F is parameter

In general,

$$\max(\text{or } \min) \quad f(x)$$
$$v_1, v_2$$
$$\text{s.t.,} \quad \text{constrain 1:}$$
$$\text{constrain 2:}$$

Endogenous : variable determined by the model
Exogenous : variables that is pre set (i.e. parameters)

e.g. marketing: Firm split a million budget on TV and radio

spending	TV	radio
0	0	0
100 k	4750	950
200 k	9000	1800
300 k	12750	2550
⋮	⋮	⋮

800k	24,000	4800
900k	24,750	4950
1m	25,000	5000

objective: maximum sales $B(T,R)$
choose variables: spending on TV (T) and radio (R)
constrain: $1m \geq T+R$

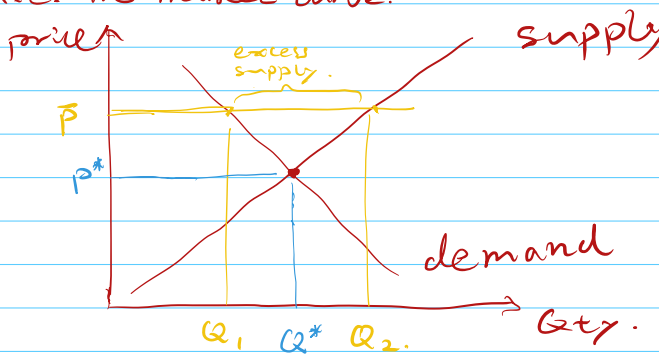
$$\max_{T,R} \quad B(T,R)$$

$$st \quad T+R \leq 1,000,000$$

Equilibrium Analysis
if the model output doesn't change,
(when the exogenous variable do not change)
then it is an equilibrium.

Example competitive equilibrium:
demand curve: quantity the market demand for any given price
supply curve: quantity the market supply for any given price

While there's no influencient on supply/demand.
This market is in equalibrium if no seller or buyer want to change their decision
i.e. the market curve.



at the point (Q^*, p^*), it reaches equilibrium.

Comparative statics:
- how does the outcome of the model change when we make change in exogenous variable and keep all else constant?

Positive versus normative analysis.

positive: explaining economic phenomas or predicting how systems change in response to other change

normative: how should we achieve serial goals, answer questions about what we should be happening