Harvest Fund Project **Version: 01**

Alternative Energy Industry Chain Modelling

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Micro-Model Building

- Notation:

Variable	Defination	Acquire Method
c	The overall cost of mine from the upstream industry chain.	
K	The product capacity of fab planning.	
$p(K)$	The price and demand function(usually linear)	
D	Market demand, consists of two part $\overline{D}$ and $\tilde{D}$	
$\overline{D}$	The stable demand in the market.	
$\tilde{D}$	The trendancy symbol of demand moving.	
h	Reputation loss since the lack of supplying.	
s	Reserving value of oversupply inventory.	

- Consider the three-node supply chain for one industry, especially new-energy lottery industry.

$$\prod_{mid} = p \cdot min(D, K) - h(D-K)^+ + s(K-D)^+ - cK$$

$$\prod_{mid} = \int_0^K [p(D) \cdot D + s(K-D)] \cdot f(D)\, dD + \int_K^\infty [p(K) \cdot K - h(D-K)] \cdot f(D) dD - cK$$

- Let the first order of the former equation to 0, thus can obtain that,

$$\begin{aligned}
\frac{\partial}{\partial K} \prod_{mid} &= [p(K) \cdot K - sK] \cdot f(K) + sF(K) + SK \cdot f(k) - p(K)K \cdot f(K) \\
&\quad + [p^{'}(K) \cdot K + p(K)] \cdot \overline{F(K)} + hK \cdot f(K) + h\overline{F(K)} - hK \cdot f(K) - c \\
&= [p^{'}(K) \cdot K + p(K)] \cdot \overline{F(K)} + h\overline{F(K)} + sF(K) - c \\
&= 0
\end{aligned}$$

- If the price function $p(D)$ maintain stable when the product has rigid market demand, the equation can be simplified to:

$$p\overline{F(K)} + h\overline{F(K)} + sF(K) = c$$
$$F_D(K) = \frac{p+h-c}{p+h-s}$$
$$K = F_D^{-1}(\frac{p+h-c}{p+h-s})$$

Macro-Model Building

- Notation:

Variable	Defination	Acquire Method
$\overline{q_t}$	The predicting output vector(n*1) of product in the period t.	
$\overline{A_t}$	The correlation matrix(n*n) of inter-product.	
$\overline{f_t}$	The predicting demand vector(m*1) by category in the period t.	
$\overline{H}$	The bridge matrix(n*m) transform the demand from category to product.	
$\overline{p_t}$	The predicting price vector(1*n) of product in the period t.	
$\overline{v_t}$	The added value vector (1*n) of each product.	

- Modelling:
  - P-STEP:

$$\overline{q_t} = A_{t-1} * \overline{q_t} + H\overline{f_t}$$
$$\overline{p_t} = \overline{p_t} * A_{t-1} + \overline{v_t}$$

  - C-STEP:

$$q_t = A_t * q_t + Hf_t$$
$$p_t = p_t * A_t + v_t$$

- Training:
  $\overline{f_t}$:
  - Method1: The predicting vector of product demand, by fitting the indicators(price index, total fixed asset) through the measurement method.
  - Method2: $\overline{f_t} = Mq_{t-1}$, while M reprensents the bridge matrix between f and q, connecting with p_{t-1}.

  A_t: Sicne A_t must be a symmetric matrix, then it can be expressed as $A_t = s_t s_t^T$

$$\min_{s_t} \quad \frac{||p_t - \tilde{p_t}||}{||p_t||} + \frac{||q_t - \tilde{q_t}||}{||q_t||}$$