

# Health Economics Exam 1 Cheat Sheet (Weeks 1-4)

## Week 1: Intro & Concepts (导论)

**Health Econ (卫生经济学):** Econ applied to health. Focus on allocation of scarce resources among competing ends. **Scarcity (稀缺性):** Resources (time, money, personnel) are limited vs. wants are unlimited. → Must choose. **Opportunity Cost (机会成本):** Value of next best alternative forgone.

$$\text{Opp Cost} = \text{Value of Best Alternative Forgone}$$

**Example:**

- **Avastin vs. Sovaldi:** Spending on cancer drug means less for Hep C drug.
- **School:** Tuition + Books + **Forgone Earnings** (因上学损失的工资).

**Rationality (理性):** 1. Completeness, 2. Transitivity, 3. Maximize Utility. **Thinking on Margin (边际思维):** Decision based on *incremental cost/benefit*. "What does ONE more unit cost/benefit?" **Positive (实证):** "What is" (Fact, objective). **Normative (规范):** "What should be" (Value, subjective).

**Production Possibility Frontier (PPF 生产可能性边界)**

Max combo of 2 goods given resources/tech.

- **On curve:** Efficient (效率最高).
- **Inside:** Inefficient (Resource wasted).
- **Outside:** Impossible (Unless Tech shift).
- **Slope:** Opportunity Cost (Give up Y to get X).
- **Shift:** Tech ↑ or Resources ↑ → Shift Out.

## Week 2: Demand for Health (健康需求)

**Utility (U, 效用):** Satisfaction. **Marginal Utility (MU):**  $\Delta U / \Delta Q$ . Diminishing **MU** (边际效用递减): First unit gives most joy. **Demand:** Willingness to Pay (WTP) = Marginal Benefit (MB).

$$MB = \frac{\Delta \text{Total Benefit}}{\Delta Q}$$

**Consumer Choice (消费者选择)**

**Indifference Curve (IC, 无差异曲线):** Bundles giving equal U.

- Downward slope, Convex to origin, Non-intersecting.
- Further from origin → Higher Utility.
- Slope: Marginal Rate of Substitution ( $MRS_{xy}$ ).

**Budget Constraint (BC, 预算约束):**  $I = P_x X + P_y Y$ . Slope =  $-P_x / P_y$ . **Equilibrium (均衡):** Max U s.t. Budget. Tangency condition (切点):

$$MRS_{xy} = \frac{P_x}{P_y} \quad (\text{Marginal Benefit Ratio} = \text{Price Ratio})$$

**Grossman Model (格罗斯曼模型)**

**Concept:** Health is **Consumption** (feel good) & **Investment** (healthy time  $h_t$  for work/leisure). **Health Capital:** Stock  $H_t$  depreciates at rate  $\delta$ . **Optimal Investment Condition:**

$$MEC = r + \delta$$

- **MEC:** Marginal Efficiency of Capital (Return on health inv).
- $r$ : Interest rate (Opportunity cost of capital).
- $\delta$ : Depreciation rate (折旧率).

- **Aging:** As Age ↑ →  $\delta \uparrow \rightarrow (r + \delta) \uparrow \rightarrow$  Optimal Health Stock  $H^*$  ↓.

**Demand Shifters (需求变动因素)**

**Movement:** Only by Own Price Δ. **Shift:** 1. **Income:** Normal (Income ↑  $D \uparrow$ ) vs. Inferior (Income ↑  $D \downarrow$ ). 2. **Related Goods:** Substitutes ( $P_y \uparrow D_x \uparrow$ ), Complements ( $P_y \uparrow D_x \downarrow$ ). 3. **Tastes:** e.g., study says apples toxic →  $D \downarrow$ . 4. **Expectations:** Expect price rise → Buy now ( $D \uparrow$ ). 5. **Population:** # Buyers ↑ →  $D \uparrow$ .

**Elasticity (弹性)**

1. **Own-Price Elasticity ( $E_d$ ):** Sensitivity of  $Q_d$  to  $P$ .

$$E_d = \frac{\% \Delta Q}{\% \Delta P} = \frac{\partial Q}{\partial P} \frac{P}{Q}$$

- $|E_d| > 1$  **Elastic:** (Luxury).  $P \uparrow \rightarrow TR \downarrow$ .
- $|E_d| < 1$  **Inelastic:** (Medical care).  $P \uparrow \rightarrow TR \uparrow$ .
- $|E_d| = 1$  **Unit:** Max Total Revenue.

2. **Cross-Price Elasticity ( $E_{xy}$ ):**

$$E_{xy} = \frac{\% \Delta Q_x}{\% \Delta P_y}$$

- $> 0$ : **Substitutes** (替代品).
- $< 0$ : **Complements** (互补品).

3. **Income Elasticity ( $E_I$ ):**

$$E_I = \frac{\% \Delta Q}{\% \Delta I}$$

- $> 0$ : **Normal** (Necessity  $0 < E < 1$ , Luxury  $E > 1$ ).
- $< 0$ : **Inferior** (低档品).

**Moral Hazard (道德风险)**

**Ex-ante (事前):** Less prevention b/c insured (smoker). **Ex-post (事后):** More treatment b/c price lower (consume until  $MB = Copay$ ). **RAND Exp:** Confirmed Demand slopes down ( $E \approx -0.2$ ). Higher copay → lower use.

## Week 3: Supply & Production (供给与生产)

**Production Func:**  $Q = f(L, K)$ . **Isoquant (等产量线):** Combos of  $L, K$  for same  $Q$ . Slope = MRTS. **Isocost (等成本线):**  $TC = wL + rK$ . Slope =  $-w/r$ . **Marginal Product (MP, 边际产量):**  $\Delta Q / \Delta L$ . **Law of Diminishing Returns:** As  $L \uparrow$  (fixed  $K$ ),  $MP_L \downarrow$ . Cobb-Douglas ( $Q = AK^\alpha L^\beta$ ):

$$MP_L = \beta \frac{Q}{L}, \quad MP_K = \alpha \frac{Q}{K}$$

**Costs (成本)**

**Short Run:**  $K$  fixed ( $TFC = rK$ ). **Long Run:** All inputs variable. **Formulas:**

- $TC = TFC + TVC$
- $ATC = TC/Q = AFC + AVC$
- $AVC = TVC/Q = wL/Q = w/AP_L$
- $MC = \Delta TC / \Delta Q = w / MP_L$

**Relationships:**

- $MC$  cuts  $ATC$  and  $AVC$  at their minimum points.
- $MP \uparrow \rightarrow MC \downarrow, MP \downarrow \rightarrow MC \uparrow$ .
- $MP > AP \rightarrow AP \uparrow$ .

**Producer Optimization (生产者优化)**

Minimize cost for given  $Q$  (Tangency of Isoquant and Isocost):

$$\frac{MP_L}{MP_K} = \frac{w}{r} \iff \frac{MP_L}{w} = \frac{MP_K}{r}$$

**Meaning:** Last dollar spent on Labor = Last dollar spent on Capital.

**Profit Max (利润最大化)**

Rule: Produce where  $MR = MC$ . Perf. Comp ( $P$  is fixed):  $P = MC$ . **Shutdown:** If  $P < \min(VC)$ , shut down in short run.

## Week 4: Market & Welfare (市场与福利)

**Equilibrium:**  $Q_s = Q_d$ . Market Clears. **Comparative Statics:**

- Demand ↑:  $P \uparrow, Q \uparrow$ .
- Supply ↑:  $P \downarrow, Q \uparrow$ .
- Demand ↑ + Supply ↓:  $P \uparrow, Q$  ambiguous.

**Welfare Analysis (福利分析)**

**CS (消费者剩余):** Area below Demand, above Price. Value of WTP - Price paid. **PS (生产者剩余):** Area below Price, above Supply. Price received - MC. **Total Surplus (TS):**  $CS + PS$ . Max at Equilibrium. **DWL (无谓损失):** Loss in TS due to distortion (Tax, Monopoly, Price Control).

**Price Controls (价格管制)**

1. **Price Ceiling (上限):** Max legal price.
  - Effective if Set <  $P^*$  (Below Eq).
  - **Consequences:** Shortage ( $Q_d > Q_s$ ), Black Market, Queues (Time cost), Quality deterioration.
2. **Price Floor (下限):** Min legal price (e.g., min wage).
  - Effective if Set >  $P^*$  (Above Eq).
  - **Consequences:** Surplus ( $Q_s > Q_d$ , Unemployment).

## Key Examples (核心例题详解)

**Ex 1: Labor Demand (Blueberry Farm)**

Given  $P = 6, W = 100$ . Find profit stats. **Rule:** Hire if  $VMP_L \geq Wage$ . ( $VMP_L = P \times MP_L$ ).

$L$	$Q$	$MP_L$	$VMP_L (6 \times MP)$	Cost	Decision
0	0	-	-	-	-
1	70	70	420	100	Yes
2	130	60	360	100	Yes
3	180	50	300	100	Yes
4	220	40	240	100	Yes
5	250	30	180	100	Yes
6	260	10	60	100	No

**Conclusion:** Optimal  $L^* = 5$ . At  $L = 6$ , cost (100) > benefit (60).

**Ex 2: Cobb-Douglas Optimization (生产要素优化)**

Given:  $Q = K^{0.4} L^{0.6}$ ,  $w = 1$ ,  $r = 1$ ,  $Cost = 200$ . Find  $K^*$ ,  $L^*$ . **Step 1: Derivatives**

$$MP_L = 0.6 \frac{Q}{L}, \quad MP_K = 0.4 \frac{Q}{K}$$

**Step 2: Optimization Condition ( $MRTS = w/r$ )**

$$\frac{MP_L}{MP_K} = \frac{0.6Q/L}{0.4Q/K} = 1.5 \frac{K}{L} = \frac{1}{1} \implies L = 1.5K$$

**Step 3: Budget Constraint**

$$wL + rK = 200 \implies 1(1.5K) + 1(K) = 200$$

$$2.5K = 200 \implies K^* = 80$$

**Step 4: Solve for L**

$$L^* = 1.5(80) \implies L^* = 120$$

**Ex 3: Doctor Productivity & Costs**

Given: 10h shift, 20 pts. Wage \$100/h, MRI \$50k (Fixed). 1. **Average Product (AP):**  $Q/L = 20/10 = 2$  pts/hr. 2. **TVC:**  $w \cdot L = 100 \times 10 = \$1000$ . 3. **AVC:**  $TVC/Q = 1000/20 = \$50$ . 4. **ATC:**  $(TFC + TVC)/Q = 51000/20 = \$2550$ . **Marginal Inference:** Since  $MP$  is diminishing ( $MP < AP$ ), the last patient takes longer than average (> 30 min), so Marginal Cost is higher than average ( $MC > \$50$ ).

**Common Mistakes & Tips**

- **Elasticity vs Slope:** They are related but NOT the same. Elasticity changes along a linear demand curve.
- **Sunk Cost:** Fixed costs (like MRI machine bought) are sunk in short run. Do not affect marginal decision ( $MC$ ).
- **Income Effect:** For inferior goods, Income ↑ →  $Q \downarrow$ .
- **Shutdown:** Compare Price to  $AVC$ , not  $ATC$ . Even if losing money, if  $P > AVC$ , keep running to cover some fixed costs.