EXERCISE 4.1 SOLUTIONS (U.S. PRODUCTION)

In either country, producing one yard of cloth uses 4 units of labor and 2 acres of land, while producing one pound of food uses 1 unit of labor and 3 acres of land. The United States has 200 units of labor and 150 acres of land.

a. What is the U.S. labor constraint?
\[ a_{LC}Q_C + a_{LF}Q_F = L, \ 4Q_C + Q_F = 200, \ Q_F = 200 - 4Q_C \]

b. What is the cloth endpoint of the U.S. labor constraint?
\[ \underline{Q}_C^L = 50 \]

c. What is the U.S. land constraint?
\[ a_{TC}Q_C + a_{TF}Q_F = T, \ 2Q_C + 3Q_F = 150, \ Q_F = 50 - \frac{2}{3}Q_C \]

d. What is the cloth endpoint of the U.S. land constraint?
\[ \underline{Q}_C^T = 75 \]

e. What U.S. production bundle fully employs both factors?

*The United States produces 20 food and 45 cloth.*

\[ 200 - 4Q_C = 50 - \frac{2}{3}Q_C \]

\[ \left(4 - \frac{2}{3}\right)Q_C = 200 - 50 \]

\[ \left(\frac{10}{3}\right)Q_C = 150, \ Q_C = 45 \]

\[ Q_F = 200 - 4Q_C = 200 - 180 = 20 \]
EXERCISE 4.2 SOLUTIONS (CANADIAN PRODUCTION)
Canada has 200 units of labor and 300 acres of land.

a. What is the Canadian land constraint?
\[ a_{TC}Q_C^* + a_{TF}Q_F^* = T \times \cdot \cdot , \quad 2Q_C^* + 3Q_F^* = 300, \quad Q_F^* = 100 - \frac{2}{3}Q_C^* \]

b. What is the cloth endpoint of the Canadian land constraint?
\[ Q_C^{T*} = 150 \]

c. What Canadian production bundle fully employs both factors?
Canada produces 80 food and 30 cloth.
\[ 200 - 4Q_C^* = 100 - \frac{2}{3}Q_C^* \]
\[ \left(4 - \frac{2}{3}\right)Q_C^* = 200 - 100 \]
\[ \left(\frac{10}{3}\right)Q_C^* = 100, \quad Q_C^* = 30 \]
\[ Q_F^* = 200 - 4Q_C^* = 200 - 120 = 80 \]

d. Compare the two countries’ supply of cloth relative to food.
The United States produces more cloth relative to food than Canada
\[ \frac{Q_C}{Q_F} = \frac{45}{20} > \frac{30}{80} = \frac{Q_C^*}{Q_F^*} \]
EXERCISE 4.3 SOLUTIONS (U.S. AUTARKY PRICING)

The price of food is always $10/pound (everywhere). The price of cloth is $10/yard in the United States under autarky.

a. What is the pricing equation for food?

\[ a_{LF}w + a_{TF}r = P_F, \quad w + 3r = 10, \quad r = \frac{10}{3} - \frac{1}{3}w \]

b. What is the wage endpoint of the pricing equation for food?

\[ \bar{w}_F = 10 \]

c. What is the U.S. pricing equation for cloth in autarky?

\[ a_{LC}w^A + a_{TC}r^A = P_C^A, \quad 4w^A + 2r^A = 10, \quad r^A = 5 - 2w^A \]

d. What is the wage endpoint of the U.S. pricing equation for cloth in autarky?

\[ \bar{w}_C^A = \frac{5}{2} \]

e. What U.S. factor prices allow both goods to be priced at cost in autarky?

*U.S. autarkic factor prices are wage 1 and rent 3.*

\[ 5 - 2w^A = \frac{10}{3} - \frac{1}{3}w^A \]

\[ \left( 2 - \frac{1}{3} \right)w^A = 5 - \frac{10}{3} \]

\[ \left( \frac{5}{3} \right)w^A = \frac{5}{3}, \quad w^A = 1 \]

\[ r^A = 5 - 2w^A = 5 - 2 = 3 \]
EXERCISE 4.4 SOLUTIONS (FREE TRADE PRICING)
The price of food is always $10/pound (everywhere). The price of cloth is $20/yard under free trade (everywhere).

a. What is the pricing equation for cloth under free trade?
\[ a_{LC}w + a_{TC}r = P_C, \ 4w + 2r = 20, \ r = 10 - 2w \]
b. What is the wage endpoint of the pricing equation for cloth under free trade?
\[ \bar{w}_C = 5 \]
c. Determine the factor prices under free trade.
*Factor prices are wage 4 and rent 2 under free trade.*
\[ 10 - 2w = \frac{10}{3} - \frac{1}{3}w \]
\[ \left(2 - \frac{1}{3}\right)w = 10 - \frac{10}{3} \]
\[ \frac{5}{3}w = \frac{20}{3}, \ w = 4 \]
\[ r = 10 - 2w = 10 - 8 = 2 \]
d. Compare U.S. factor prices under free trade to autarky.
*In the United States, the wage to rent ratio rises in the move from autarky to free trade.*
\[ \frac{w}{r} = \frac{4}{2} > \frac{1}{3} = \left( \frac{w}{r} \right)^A \]
e. Who would oppose free trade in each country?
*U.S. landlords and Canada workers*
EXERCISE 4.5 SOLUTIONS (COMPARATIVE ADVANTAGE)

In either country, producing one yard of cloth uses 4 units of labor and 2 acres of land, while producing one pound of food uses 1 unit of labor and 3 acres of land. The United States has 200 units of labor and 150 acres of land. Canada has 200 units of labor and 300 acres of land.

a. Which country is relatively abundant in labor to land?

*The United States has a relative abundance in labor to land.*

\[
\frac{4}{3} = \frac{200}{150} = \frac{L}{T} > \frac{L^*}{T^*} = \frac{200}{300} = \frac{2}{3}
\]

b. Which good makes relatively intensive use of labor to land?

*Cloth production is relatively intensive in labor to land.*

\[
\frac{2}{4} = \frac{\frac{4}{2}}{a_{LC}/a_{TC}} > \frac{\frac{4}{2}}{a_{LF}/a_{TF}} = \frac{1}{3}
\]

c. Determine the pattern of comparative advantage and the pattern of trade.

*The United States has comparative advantage in cloth and Canada in food. The United States exports cloth and Canada exports food.*