Swiss Institute of Artificial Intelligence
MSc Data Science & MBA AI/BigData
Data-based Decision Making

TA Solution
Problem Set 1
September 11, 2021

Question 1
Productivity of 1 labour unit:

	SI	AI
Math	15	10
Stat	30	40

1. Absolute advantage in the production of Math: SI ($15 > 10$)
   Absolute advantage in the production of Stat: AI ($30 < 40$)

2. SI's opportunity cost of 1 Math: $\dfrac{30}{15} = 2$ Stat (cheaper than AI's)

   AI's opportunity cost of 1 Math: $\dfrac{40}{10} = 4$ Stat

   SI's opportunity cost of 1 Stat: $\dfrac{15}{30} = \dfrac{1}{2}$ Math

   AI's opportunity cost of 1 Stat: $\dfrac{10}{40} = \dfrac{1}{4}$ Math (cheaper than SI's)
   Comparative advantage in the production of Math: SI

   Comparative advantage in the production of Stat: AI

3. SI would export Math in exchange for Stat. SI will focus on producing Math in which they have comparative advantage.

4. It depends on the barter ratio of Math/Stat.
   Under 2 labour unit, SI and AI will produce as below:

Autarky	SI	AI
Math	15	10
Stat	30	40

Trade O	SI	AI
Math	30	0
Stat	0	80

   Let $x = \dfrac{Math}{Stat}$ barter ratio

   SI's benefit condition: $15 + 30x < 30 \quad 30x < 15 \quad \therefore x < 0.5$
   AI's benefit condition: $10 + 40x < 80 \quad 10 < 40x \quad \therefore 0.25 < x$
   If $0.25 < x < 0.5$, both would benefit from trade. (You can explain other conditions)

5. $terms\ of\ trade = \dfrac{export\ price\ index}{import\ price\ index} \cdot 100$
   As $x = $ Math/Stat, $100x$ means terms of trade for SI. If $P_{math} = 0.2 \cdot P_{Stat}$, AI would refuse to trade. For AI, Autarky production would be $10 + 40x = 10 + 8 = 18$, Free trade production would be $80x = 16$

6. There is no comparative advantage.

Question 2
Productivity of 1 labour unit:

	SI	AI
R	20	10
C	10	20

Absolute advantage in the production of Reasoning: SI
Absolute advantage in the production of Coding: AI
Comparative advantage in the production of Reasoning: SI
Comparative advantage in the production of Coding: AI

Let x = Reasoning/Coding barter ratio,
SI's trading condition: $20 + 10x \leqq 20 \quad x \leqq 2$
AI's trade condition: $10 + 20x \leqq 40x \quad 0.5 \leqq x$

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1. False

2. False

3. True

4. True

5. True

Question 3
Productivity of 1 labour unit:

	Stonia	Venia
Stuff	$\frac{300}{2} = 150$	$\frac{600}{4} = 150$
Nonsense	$\frac{300}{1} = 300$	$\frac{600}{5} = 120$

Question 4
If 60hr is 1 unit labour hour, productivity of 1 labour unit:

	HQ car	LQ car
High-tech countries	$\frac{60}{30} = 2$	$\frac{60}{20} = 3$
Other countries	$\frac{60}{60} = 1$	$\frac{60}{30} = 2$

1. Absolute advantage at making high-quality cars: High-tech countries
   Absolute advantage at making low-quality cars: High-tech countries

2. Opportunity cost of making high-quality cars in high-tech countries: $\frac{3}{2} = 1.5$ LQ car (cheaper)

   Opportunity cost of making high-quality cars in other countries: $\frac{2}{1} = 2$ LQ car

   Opportunity cost of making low-quality cars in high-tech countries: $\frac{2}{3}$ HQ car

   Opportunity cost of making low-quality cars in other countries: $\frac{1}{2}$ HQ car (cheaper)

3. Comparative advantage for manufacturing high-quality cars: High-tech countries
   Comparative advantage for manufacturing low-quality cars: Other countries

Problem 5
Productivity of 1 labour unit:

	Computer	Wheat
Australia	25	25
Taiwan	30	50

1. Australia's opportunity cost of making a computer: $\frac{25}{25} = 1$ bushels of wheat

   Taiwan's opportunity cost of making a computer: $\frac{50}{30} = \frac{5}{3}$ bushels of wheat

2. Australia's opportunity cost of making a bushel of wheat: $\frac{25}{25} = 1$ computer

   Taiwan's opportunity cost of making a bushel of wheat: $\frac{30}{50} = \frac{3}{5}$ computer

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3. No absolute advantage in producing computers and bushels of wheat.

4. Australia has comparative advantage in producing a computer. (cheaper opportunity cost)

5. Taiwan has comparative advantage in producing a bushel of wheat. (cheaper opportunity cost)

6. Australia's condition to gain by trading:
   Let x = computer/wheat barter ratio,
   $25 + 25x < 50 \quad \therefore x < 1$

7. Taiwan's condition to gain by trading:
   $30 + 50x < 100x \quad \therefore \frac{3}{5} < x$

8. Australia and Taiwan will not trade if the barter ratio x(computer/wheat) is $x < \frac{3}{5}$ or $1 < x$