ECON 173 - Intermediate Microeconomic Analysis
Drake University, Fall 2022
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EXAMINATION #4 ANSWER KEY

Version A

I. Multiple choice

(1)e. (2)b. (3)b. (4)b. (5)c. (6)a. (7)b. (8)d. (9)b. (10)a. (11)a. (12)e.

II. Short answer

(1) a. 2 units of clothing. b. 1/2 units of food. c. slope = -2.
d. P_{food} = \$12, because slope of each consumer's budget line = $-P_{food}/P_{clothing}$ = -2.

(2) a. $P_A = MC / (1 + [1/\varepsilon_A])$ = \$16.
b. $P_C = MC / (1 + [1/\varepsilon_C])$ = \$10.

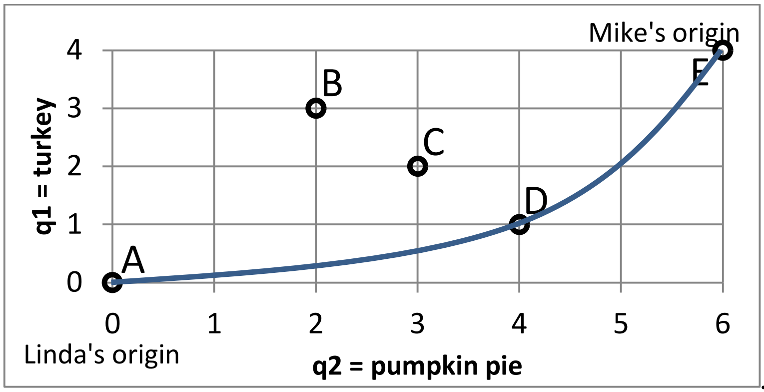
(3) a. $L = 1/|\varepsilon| = 0.5$. b. $L = 1 / (n\, |\varepsilon|) = 0.1$.

(4) a. \$7. b. 6 thousand. c. \$0 because P=MC.
d. MR = 13 – 2Q ("Same intercept, twice the slope").
e. Plot MR as a straight line with P-intercept = \$13, slope = -2/thousand.
f. \$9. g. 4 thousand. h. \$4 thousand.

(5) a. Pareto optimal: no, no, yes, yes.
b. Dominant-strategy equilibria: no, no, no, no.
c. Nash equilibria in pure strategies: no, no, yes, yes.

III. Problems

(1) [Exchange efficiency] Note that Linda's $MRS_L = 3q_1/q_2$ and Mike's $MRS_M = q_1/(2q_2)$.
a. **Yes,** A is Pareto-efficient, because no one can be made better off without someone else being made worse off. Mike has everything, so he cannot be made better off. Linda has nothing, so she cannot be made better off without taking some of Mike's turkey or pumpkin pie, which would make Mike worse off. Put simply, since Mike already has everything, any feasible change would make Mike worse off.
b. **No**, B is not Pareto-efficient, because $MRS_L = 9/2 \neq MRS_M = 1/8$.
c. **No**, C is not Pareto-efficient, because $MRS_L = 2 \neq MRS_M = 1/3$.
d. **Yes,** D is Pareto-efficient, because $MRS_L = 3/4 = MRS_M = 3/4$.
e. **Yes,** E is Pareto-efficient, because no one can be made better off without someone else being made worse off. Linda has everything, so she cannot be made better off. Mike has nothing, so he cannot be made better off without taking some of Linda's turkey or pumpkin pie, which would make Linda worse off. Put simply, since Linda already has everything, any feasible change would make Linda worse off.

f. 

(2) [Monopoly, profit maximization]

a. MC = dTC/dQ = **3 + (Q/10).**

b. AC = TC/Q = **3 + (Q/20).**

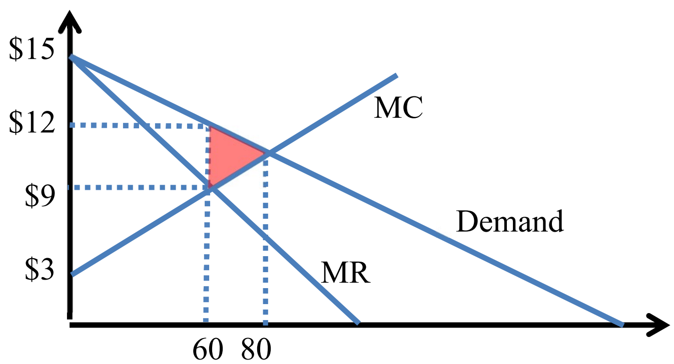
c. First find total revenue = P×Q = 15Q – (Q^2/20). So MR = dTR/dQ = **15 – (Q/10).**

d. Set MC = MR and solve to get Q_M = **60**.

e. Substitute into demand function: P_M = 15 – (60/20) = **$12**.

f. Profit = TR – TC = (60×12) – (3×60 + 60^2/20) = **$360**.

g. The efficient level of output lies where marginal cost intersects demand ("marginal cost pricing"). Find this quantity by setting 15 – (Q/20) = 3 + (Q/10), which yields Q=80. Then find MC(60) = 3 + (60/10) = $9. Then evaluate DWL as the area of a triangle: **$30** (see red triangle below).



(3) [Cournot duopoly]

a. $TR_1 = P\, q_1 =$ **$14q_1 - (q_1^2/10) - (q_1q_2/10)$.**

b. $MR_1 = \partial TR_1(q_1,q_2) / \partial q_1 =$ **$14 - (2q_1/10) - (q_2/10)$.**

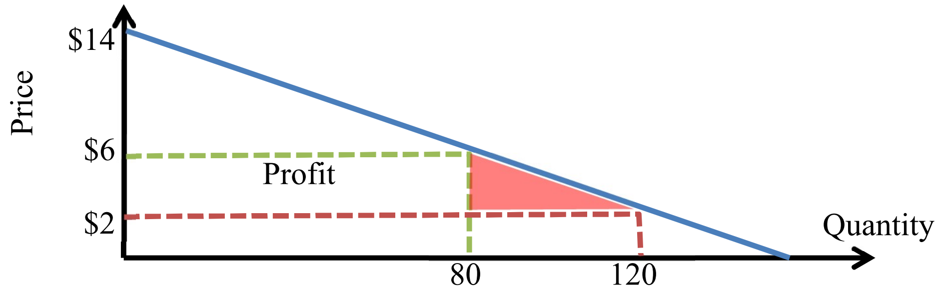
c. Set MR_1 = MC = $2 and solve to get **$q_1^* = 60 - (q_2/2)$.**

d. Since $q_1^* = q_2^*$, $q_1^* = 60 - q_1^*/2$. Solving yields **$q_1^* = 40$** $= q_2^*$.

e. $Q^* = q_1^* + q_2^* =$ **80**. Substituting into demand equation: P* = 14 – (80/10) = **$6.**

f. Profit = (P*×Q*) – (AC×Q*) = (P*-AC)×Q* = (6-2)×80 = **$320.**

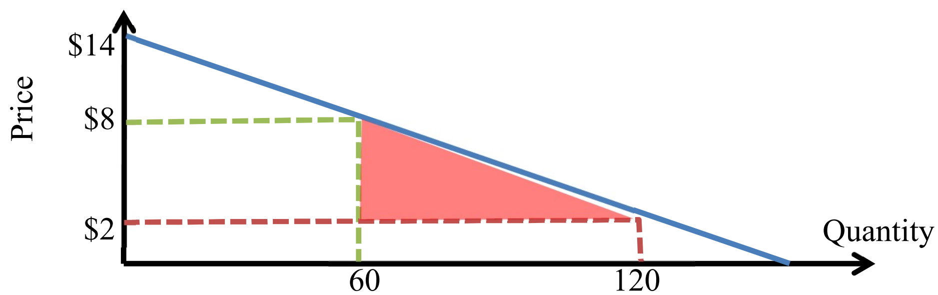
g. The efficient level of output lies where marginal cost intersects demand ("marginal cost pricing"). Find this quantity by setting MC = $2 = P = 14 – (Q/10) and solving to get Q = 120. Deadweight loss is the area between demand and marginal cost, from the Cournot equilibrium quantity Q*=80 to the efficient quantity = 120 (see below). This is the area of a triangle, equal to **$80** (see red triangle below).



IV. Critical thinking

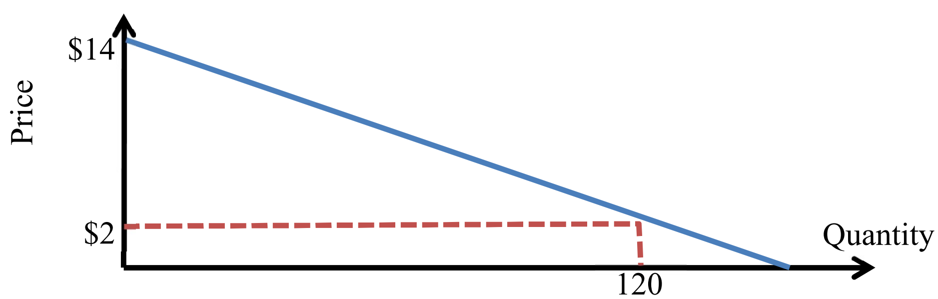
(1) Collusion

Firms collude to maximize the sum of their profits. Since the two firms have the same constant marginal cost, it does not matter which firm produces the output, and MC_J = \$2. Since demand is given by P = 14 – (Q/10), MR has same intercept and twice the slope, or MR = 14 – (2Q/10). Set MR = MC_J and solve to get **Q_C = 60**. Substitute into demand to get **P_C = \$8.** Now the efficient quantity, at the intersection of MC and demand, was found in problem (3) to be 120. Therefore, **deadweight loss = \$180** (see red triangle below).



(2) Price-setting ("Bertrand") duopoly

In a price-setting duopoly, the equilibrium is for both firms to set a price equal to marginal cost, which here is **P* = \$2**. Substituting into the demand equation \$2 = 14 – (Q/10) gives **Q* = 120**. Since P* = marginal cost, **deadweight loss = 0.**



Version B

I. Multiple choice

(1)a. (2)e. (3)d. (4)a. (5)b. (6)b. (7)c. (8)e. (9)c. (10)b. (11)c. (12)d.

II. Short answer

(1) a. 3 units of clothing. b. 1/3 units of food. c. slope = -3.
d. P_{food} = \$18, because slope of each consumer's budget line = $-P_{food}/P_{clothing}$ = -3.

(2) a. $P_A = MC / (1 + [1/\varepsilon_A])$ = \$9.
b. $P_C = MC / (1 + [1/\varepsilon_C])$ = \$8.

(3) a. $L = 1/|\varepsilon| = 0.25$. b. $L = 1 / (n\,|\varepsilon|) = 0.05$.

(4) a. \$9. b. 8 thousand. c. \$0 because P=MC.
d. MR = 13 – Q ("Same intercept, twice the slope").
e. Plot MR as a straight line with P-intercept = \$13, slope = -1/thousand.
f. \$10. g. 6 thousand. h. \$3 thousand.

(5) a. Pareto optimal: yes, no, yes, yes.
b. Dominant-strategy equilibria: no, yes, no, no.
c. Nash equilibria in pure strategies: no, yes, no, no.

III. Problems

(1) [Exchange efficiency] Note that Linda's $MRS_L = q_1/q_2$ and Mike's $MRS_M = 5q_1/q_2$.

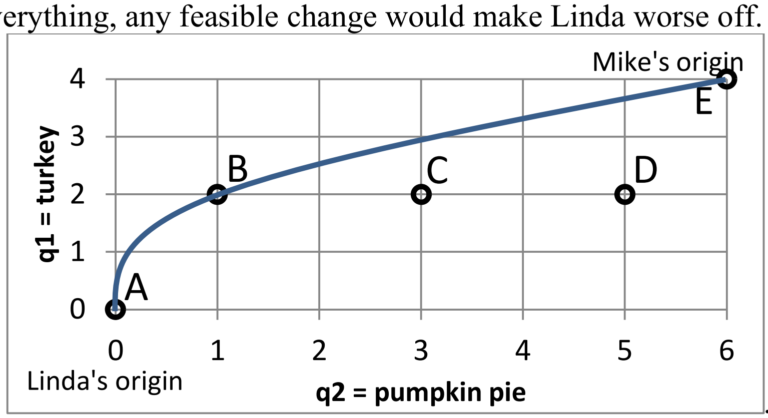
a. **Yes,** A is Pareto-efficient, because no one can be made better off without someone else being made worse off. Mike has everything, so he cannot be made better off. Linda has nothing, so she cannot be made better off without taking some of Mike's turkey or pumpkin pie, which would make Mike worse off. Put simply, since Mike already has everything, any feasible change would make Mike worse off.

b. **Yes,** B is Pareto-efficient, because $MRS_L = 2 = MRS_M = 2$.

c. **No**, C is not Pareto-efficient, because $MRS_L = 2/3 \neq MRS_M = 10/3$.

d. **No**, D is not Pareto-efficient, because $MRS_L = 2/5 \neq MRS_M = 10$.

e. **Yes,** E is Pareto-efficient, because no one can be made better off without someone else being made worse off. Linda has everything, so she cannot be made better off. Mike has nothing, so he cannot be made better off without taking some of Linda's turkey or pumpkin pie, which would make Linda worse off. Put simply, since Linda already has everything, any feasible change would make Linda worse off.

f. 

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(2) [Monopoly, profit maximization]

a. MC = dTC/dQ = **4 + (Q/10).**

b. AC = TC/Q = **4 + (Q/20).**

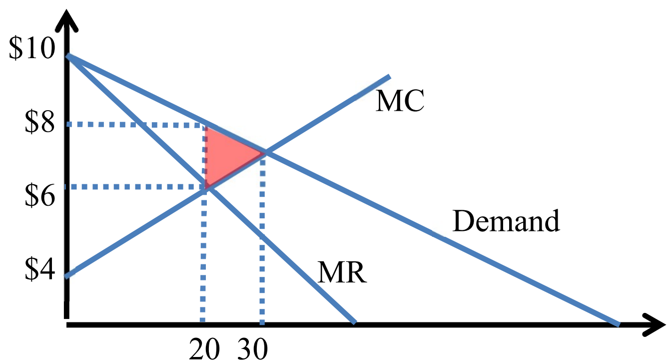
c. First find total revenue = P×Q = 10Q – (Q^2/10). So MR = dTR/dQ = **10 – (2Q/10).**

d. Set MC = MR and solve to get Q_M = **20**.

e. Substitute into demand function: P_M = 15 – (60/20) = **$8**.

f. Profit = TR – TC = (20×8) – (4×20 + 20^2/20) = **$60**.

g. The efficient level of output lies where marginal cost intersects demand ("marginal cost pricing"). Find this quantity by setting 10 – (Q/10) = 4 + (Q/10), which yields Q=30. Then find MC(220) = 4 + (20/10) = $6. Then evaluate DWL as the area of a triangle: **$10** (see red triangle below).



(3) [Cournot duopoly]

a. TR_1 = P q_1 = **$11q_1 – (q_1^2/10) – (q_1q_2/10)$.**

b. $MR_1 = \partial TR_1(q_1,q_2) / \partial q_1$ = **$11 – (2q_1/10) – (q_2/10)$.**

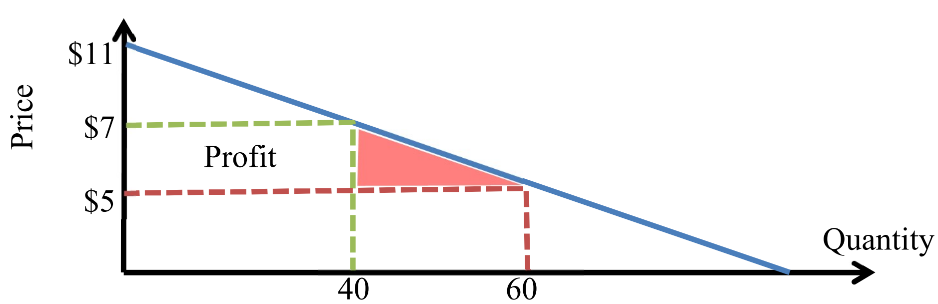
c. Set MR_1 = MC = $5 and solve to get **$q_1^* = 30 – (q_2/2)$.**

d. Since $q_1^* = q_2^*$, $q_1^* = 30 – q_1^*/2$. Solving yields **$q_1^* = 20$** $= q_2^*$.

e. Q* = $q_1^* + q_2^*$ = **40**. Substituting into demand equation: P* = 11 – (40/10) = **$7.**

f. Profit = (P*×Q*) – (AC×Q*) = (P*-AC)×Q* = (7-5)×40 = **$80.**

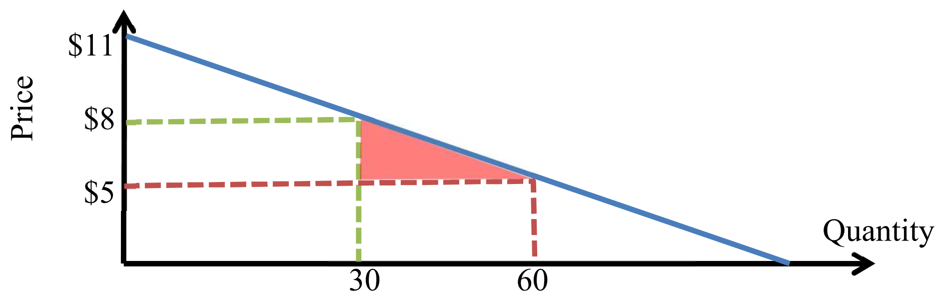
g. The efficient level of output lies where marginal cost intersects demand ("marginal cost pricing"). Find this quantity by setting MC = $5 = P = 11 – (Q/10) and solving to get Q = 60. Deadweight loss is the area between demand and marginal cost, from the Cournot equilibrium quantity Q*=40 to the efficient quantity = 60 (see below). This is the area of a triangle, equal to **$20** (see red triangle below).



IV. Critical thinking

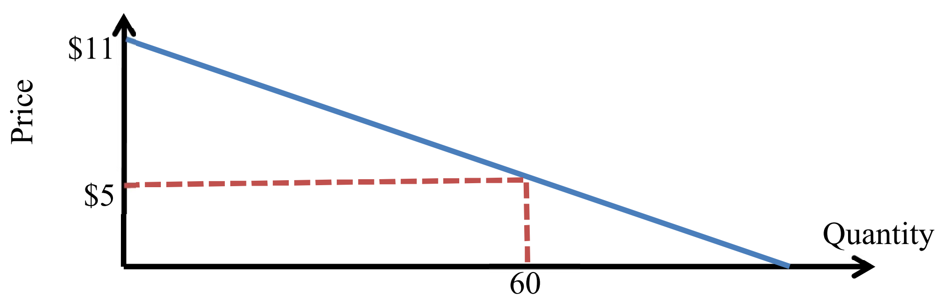
(1) Collusion

Firms collude to maximize the sum of their profits. Since the two firms have the same constant marginal cost, it does not matter which firm produces the output, and $MC_J = \$5$. Since demand is given by $P = 11 - (Q/10)$, MR has same intercept and twice the slope, or $MR = 11 - (2Q/10)$. Set $MR = MC_J$ and solve to get $\mathbf{Q_C = 30}$. Substitute into demand to get $\mathbf{P_C = \$8.}$ Now the efficient quantity, at the intersection of MC and demand, was found in problem (3) to be 60. Therefore, **deadweight loss = $45** (see red triangle below).



(2) Price-setting ("Bertrand") duopoly

In a price-setting duopoly, the equilibrium is for both firms to set a price equal to marginal cost, which here is **P* = $5**. Substituting into the demand equation $\$5 = 11 - (Q/10)$ gives **Q* = 60**. Since P* = marginal cost, **deadweight loss = 0.**



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