

Midterm (ANSWER KEY)

ECNS 432

Spring 2021

Due to me via email (dwight.anderson@montana.edu) by noon on Friday, March 5th

_____ Name

1.) Consider a section of freeway that is uncongested during off-peak hours, but congested during rush hour. Suppose the trip to and from work takes 40 min. when the freeway is uncongested. Also, supposed that taking the side streets to and from work **always** takes 60 min.

On the freeway, assume congestion effects occur only after the 3rd car. After the 3rd car, each additional car that enters the freeway adds 5 minutes of travel time to all freeway commuters.

Lastly, assume that all commuters value their time at \$12/hour (or, equivalently \$.20/min).

a.) (7 points) Given the open access to the freeway, how many cars will travel on the freeway?

Cars	ave. time	total time	marginal time
1	40	40	40
2	40	80	40
3	40	120	40
4	45	180	60
5	50	250	70
6	55	330	80
7	60	420	90
8	65	520	100
9	70	630	110
10	75	750	120

Cars will enter to the point that average time on the freeway is equal to the trip time on the side streets. As a result, 7 cars will enter when there is open access to the freeway.

b.) (7 points) Suppose the freeway is now privately owned. What toll would be charged by the owner and how many cars would now travel on the freeway?

The owner would charge a toll such that cars would enter the freeway to the point where marginal time is equal to the trip time on the side streets. As a result, 4 cars will travel on the freeway when it is privately owned. And, the owner will charge a toll of \$3.

c.) (6 points) Which situation is efficient (i.e. open access freeway vs. privately owned freeway)? WHY?

The open access freeway is inefficient because cars 5, 6, and 7 could be allocated to different routes (i.e. the side streets) to decrease total commute time of all commuters. The privately owned freeway is efficient because cars 1 through 4 could not be reallocated in any other manner to decrease the total trip time of all commuters.

2.) Suppose we have an efficiently operating market for good X. Also, suppose the government adds a sufficiently large quantity of good X to the market such that the price of good X decreases (as shown in the graph below).

Use the graph below to answer the following:

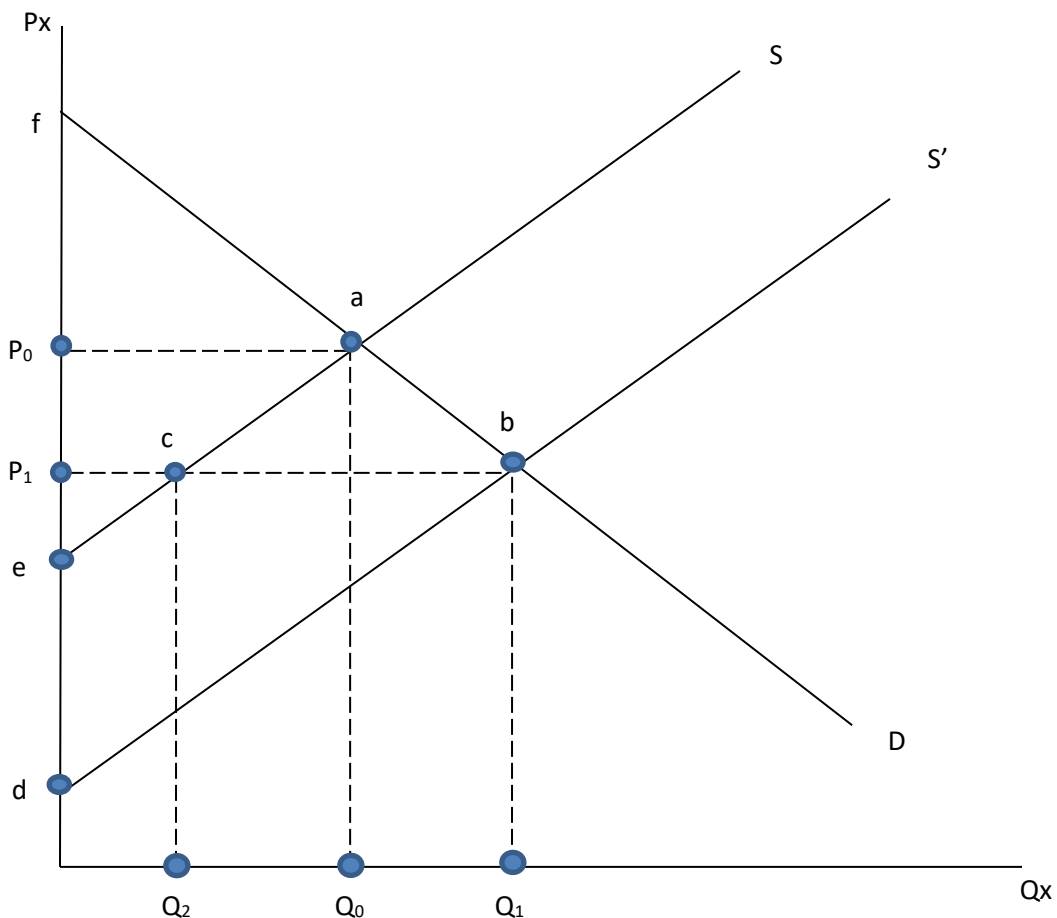
a.) (2 points) The gain in consumer surplus is given by what area on the graph? P_0abP_1

b.) (2 points) Which supply curve do private sector suppliers operate on, S or S'? S

c.) (2 points) The loss in producer surplus is given by what area on the graph? P_0acP_1

d.) (2 points) Government surplus is given by what area on the graph? Q_2cbQ_1

e.) (2 points) The overall gain in social surplus is given by what area on the graph? Q_2cabQ_1



3.) Suppose we have an efficiently operating market for cigarettes (our primary market good). Also, consider the secondary markets for chewing tobacco and whiskey. Cigarettes and chewing tobacco are substitutes, while cigarettes and whiskey are complements.

Now assume the government imposes a tax of t_x per unit (e.g., a pack) on sellers in the cigarette market.

a.) (5 points) Suppose the supply schedule in the market for whiskey is perfectly elastic and this market operates efficiently. Do we count changes in surplus that occur in the market for whiskey (due to the tax in the primary market) in our welfare analysis of the primary market? Why or why not? Keep your answer to a sentence or two.

No, all changes are accounted for already in the primary market. We do not want to double count the increase in consumer surplus.

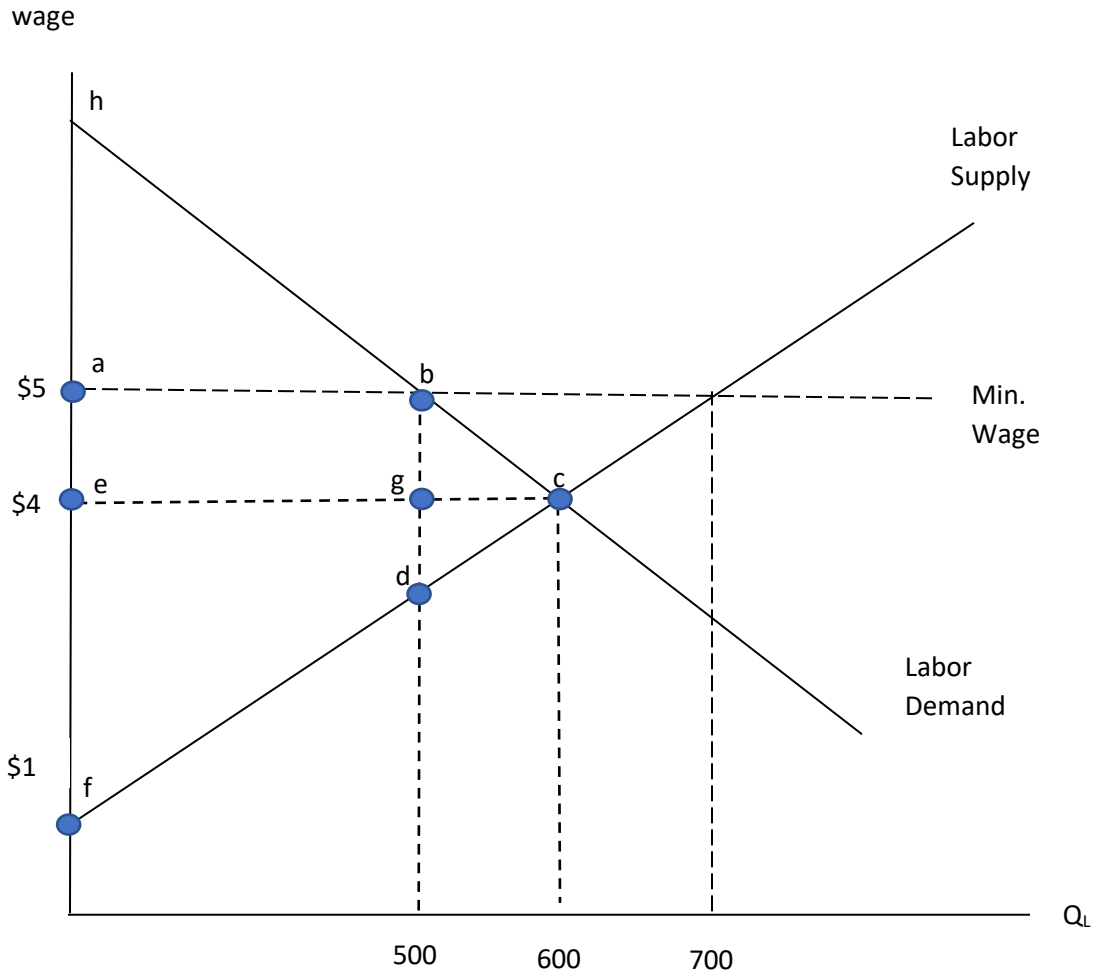
b.) (10 points) Suppose the supply schedule in the market for chewing tobacco is upward sloping. Furthermore, suppose there exists a government-maintained price support (aka price floor) in this market. **Illustrate graphically** what happens in this market when the tax in the primary market is imposed (assume the demand for chewing tobacco shifts such that the price floor is still binding). Do we count any changes in this secondary market in our welfare analysis of the primary market?

-We do not count changes in consumer surplus (already accounted for)...because the price floor is still binding after the demand shift, price has not changed for the consumer.

-Producer surplus in the secondary market does not change given that the government buys up the surplus and the price floor remains binding after the demand shift.

-BUT, the DWL gets smaller...and this is a change that we would want to count!

4.) Consider a low-wage labor market. Workers in this market are not presently covered by the minimum wage, but the government is considering implementing such legislation. If implemented, this law would require employers to pay workers a \$5 hourly wage. Suppose all workers in the market are equally productive, the current market-clearing wage is \$4 per hour, and that at this market-clearing wage there are 600 employed workers. Further suppose that under the minimum wage legislation, only 500 workers would be employed and 200 workers would be unemployed. Finally, assume that the market demand and supply curves are linear and that the market reservation wage, the lowest wage at which any worker in the market would be willing to work, is \$1 per hour. The graph below depicts this situation.



a.) (3 points) Which area in the graph represents the change in employer surplus due to the minimum wage? Calculate this change in employer surplus (making sure to indicate whether it is positive or negative). *abce is a loss in employer surplus. This amount is equal to $-\left[(\$5 - \$4) \times 500 + \frac{1}{2} \times 100 \times (\$5 - \$4) \right] = -\550*

b.) (3 points) Which area represents the new employee surplus? (i.e., employee surplus after the minimum wage has been implemented) Is the change in employee surplus positive or negative? **abdf is the new employee surface. The gain in employee surplus of abge clearly outweighs the loss in employee surplus of gcd.**

c.) (3 points) Which area represents a transfer from employers to employees? **abge is a transfer from employers to employees**

d.) (3 points) Which area represents the total impact of the minimum wage on employers and employees as a whole? Is this amount positive or negative? **The DWL is bcd and this is clearly negative.**

e.) (3 points) Finally, 100 workers are induced by the higher wage to enter the market. Do these workers experience a change in surplus that should be counted in a welfare analysis? Why or why not? **Because these individuals neither had a job before or after the min. wage policy, they see no change in surplus.**

5.) (10 points) Suppose MSU is trying to decide how to use a piece of land. One option is to put up an outdoor rock-climbing wall with an expected life of 3 years. Another is to install an outdoor swimming pool with an expected life of 6 years. The climbing wall would cost \$120,000 to construct and would yield net benefits of \$46,000 at the end of each of the 3 years. The swimming pool would cost \$500,000 and would yield net benefits of \$100,000 at the end of each of the 6 years. Each project is assumed to have zero salvage value at the end of its life. Using a real discount rate of 5 percent, which project offers larger net benefits? (HINT: Notice that the proposed project lengths are not the same.)

As only one of these projects can be built on the site, they are mutually exclusive. The comparison is complicated because the swimming pool has an expected life two times longer than the rock-climbing wall.

Consider first the NPV of each project separately:

NPV(one climbing wall project)

$$= -\$120,000 + \sum_{i=1}^3 \frac{46,000}{(1+0.05)^i} = \$5,269$$

NPV(one swimming pool project)

$$= -\$500,000 + \sum_{i=1}^6 \frac{100,000}{(1+0.05)^i} = \$7,569$$

If we choose on the basis of this comparison, then the swimming pool has a larger present value of net benefits. However, this is not appropriate as the projects are of different lengths. One possible correct approach is the following:

One could choose between one swimming pool and two successive climbing wall projects so that the site is used in each case for the same length of time.

NPV(two successive climbing wall projects)

$$= \$5,269 + \$5,269/(1+.05)^3$$

$$= \$9,821$$

Thus, two successive climbing wall projects offer a higher present value of net benefits than the swimming pool project. One should build the climbing wall.

6.) A beekeeper and an apple orchard farmer are neighbors. This is convenient for the farmer because the bees pollinate her trees: one beehive pollinates one acre of apple trees.

But, there are not enough bees to pollinate the entire orchard and pollination costs are \$15/acre.

Suppose the beekeeper has total costs that can be represented as follows:

$$TC = H^2 + 20H + 5,$$

where H is the number of hives and each hive yields \$30 worth of honey.

a.) (5 points) How many hives would the beekeeper maintain if operating independently of the farmer? What are the beekeeper's profits?

$$\max \Pi = 30H - (H^2 + 20H + 5)$$

$$\rightarrow d\Pi/dH = 30 - 2H - 20 = 0$$

$$\rightarrow 2H = 10$$

$$\rightarrow H = 5$$

$$\Pi = 30(5) - (5^2 + 20*5 + 5) = \$20$$

b.) (5 points) What is the socially efficient number of hives?

Setting $MB_{soc} = MC_{soc}$, implies the following

$$30 + 15 = 2H + 20$$

$$2H = 25$$

$$H^* = 12.5$$

c.) (5 points) In the absence of transaction costs, we know the beekeeper and farmer will negotiate with each other and the socially efficient solution will be reached. How high would total transaction costs have to be to erase all gains from bargaining?

$$\text{Benefit to the orchard owner is } (12.5 - 5)*(\$15) = \$112.5$$

Costs to beekeeper of increasing production from 5 to 12.5:

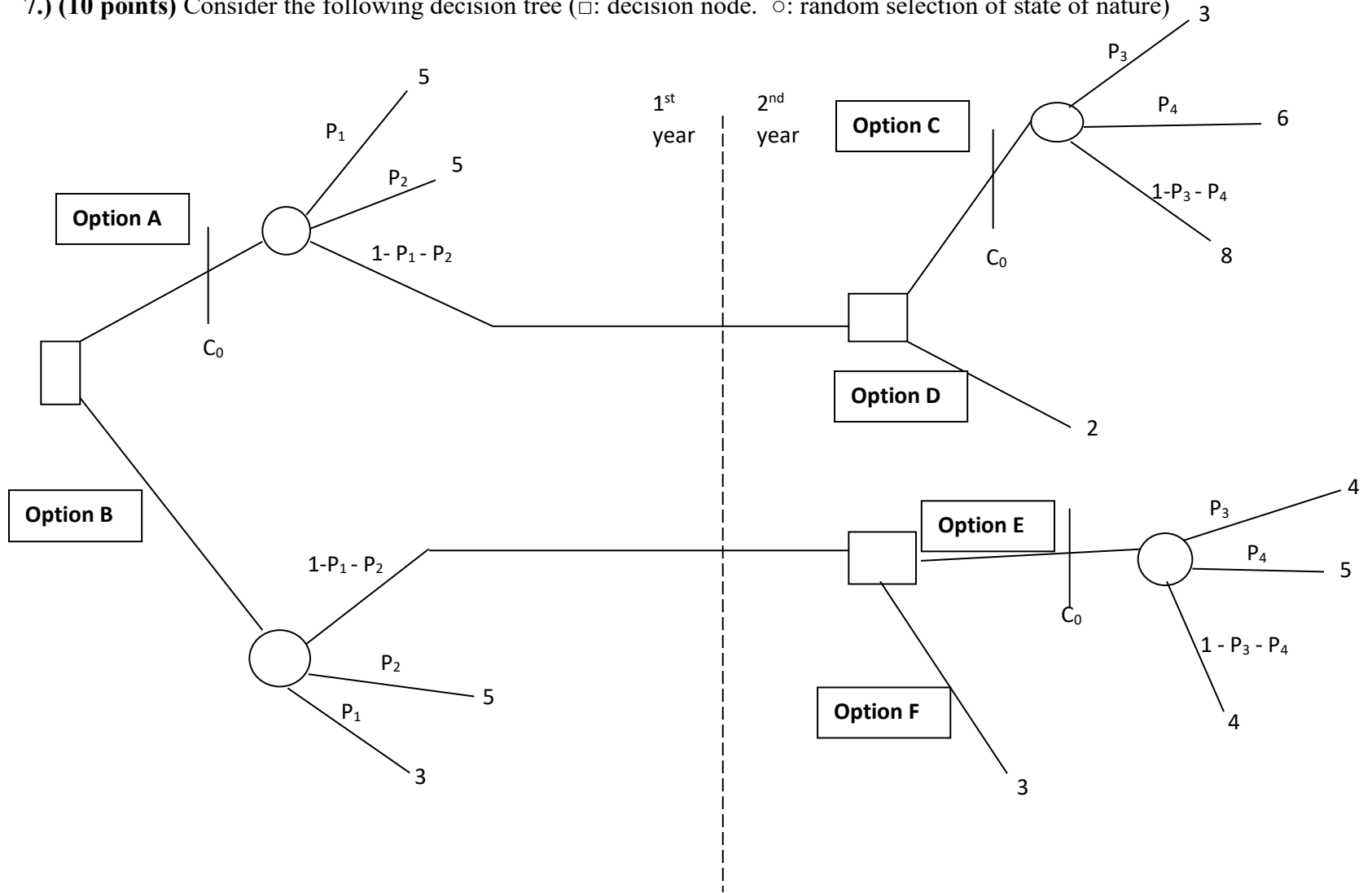
$$\Pi(H=5) = \$20$$

$$\Pi(H=12.5) = (30*12.5) - (12.5^2 + 20*12.5 + 5) = 375 - (156.25 + 250 + 5) = -\$36.25$$

→ $\Pi(H=5) - \Pi(H=12.5) = \$20 - (-\$36.25) = \56.25 (private costs to beekeeper of producing 7.5 more hives)

Therefore, we know that any amount they negotiate upon between \$56.25 and \$112.50 will lead to the socially efficient outcome. As a result, if transaction costs exceed \$56.25, there can exist no agreement that would make both parties better off.

7.) (10 points) Consider the following decision tree (\square : decision node. \circ : random selection of state of nature)



The above decision tree represents a two-period game where you (as a policy-maker) must decide between several combinations of policies. The values given represent **benefits**. So, for example, if you choose option A in the first period, then you stand to gain the following benefits: \$5 (with probability P_1), \$5 (with probability P_2), or you carry on to period 2 (with probability of $1 - P_1 - P_2$). There are four possible policy combinations you have to choose from: (A, C); (A, D); (B, E); (B, F). Given the following parameters, which option yields the greatest expected net benefits?

- $P_1 = 0.3$
- $P_2 = 0.5$
- $P_3 = 0.5$
- $P_4 = 0.4$
- $C_0 = 2$ (This represents a cost that you must incur if you choose options A, C, or E)
- Assume a discount rate of 0.10.

Solving via backwards induction:

$$E[C] = 2.7 \quad \text{vs.} \quad E[D] = 2$$

If we choose A in the first period, then we know we will choose C in the second period.

$$E[E] = 2.4 \quad \text{vs.} \quad E[F] = 3$$

If we choose B in the first period, then we know we will choose F in the second period.

So, our problem ultimately boils down to comparing policy (A, C) with policy (B, F). In calculating the expected benefits associated with each, we find that

$$E[(A, C)] = 2.49 \quad \text{and} \quad E[(B, F)] = 3.95.$$

Policy (B, F) should be chosen.