Microeconomics Honors Exam

The Tale of Cookie Monster, Harvard Class of 2013

Solutions

**NOTE:** Each question is worth 25 points and can be completed without completing the other three questions.

1. Cookie Monster gets a job as an analyst at Goldman Sachs. He used to like cookies, but now Cookie Monster only likes coffee and leisure. His utility function is where c is cups of coffee and l is hours of leisure. Coffee costs $4 a cup. Cookie Monster has H hours to allocate between work and leisure, and he earns $40 for each hour he works.
   1. (5 points) Express Cookie Monster’s maximization problem, including budget constraint.

Cookie monster must solve

The amount of coffee he consumes must be equal to his income.

* 1. (10 points) Solve for the optimal consumption of coffee and leisure as a function of hours H.

Substituting in the budget constraint gives

Solving gives

Cookie monster works for and consumes as leisure. Working gives him income which allows him to afford cups of coffee.

* 1. (5 points) Suppose Cookie Monster suddenly realizes he no longer needs sleep and H increases. What happens to his consumption of coffee? (Assume that the change in the need for sleep and any change in consumption of coffee are unrelated except through the change in H.) Is coffee a normal good, an inferior good, or neither?

Since Cookie Monster consumes cups of coffee, his coffee consumption will increase as H increases. Thus, coffee is a normal good.

* 1. (5 points) Are coffee and leisure complements, substitutes, or neither? Explain.

Neither. A change in the price of leisure or coffee has no effect on the allocation of hours between work and leisure.

1. Cookie Monster decides to celebrate his Saturday night off by taking his girlfriend, Pie Monster, out for dessert. They can either go out for cookies or for pie. While Cookie Monster and Pie Monster are debating on the phone whether to meet at the cookie store or the pie store, Cookie Monster’s cell phone battery dies. Thus, both must decide where to go without having agreed on where to meet. Both Cookie and Pie Monster know that the utility for each from each option

is as follows:

|  |  |  |  |
| --- | --- | --- | --- |
|  |  | Pie Monster | |
|  |  | Cookies | Pie |
| Cookie Monster | Cookies | 4,2 | 0,0 |
| Pie | 0,0 | 2,4 |

* 1. (5 points) Find all pure strategy Nash equilibria of this game.

There are two pure strategy NE: (cookies, cookies) and (pie, pie).

* 1. (5 points) Are there any mixed strategy Nash equilibria? If so, find them. What is the expected payoff to each player in each mixed strategy Nash equilibrium (if there are any)?

There is one mixed strategy Nash equilibrium. Each player will mix to make the other indifferent between his or her two strategies. Let p be the probability that Cookie Monster picks cookies and q the probability that Pie Monster picks cookies. Then we must have

The equilibrium is for Cookie Monster to choose cookie with probability and for Pie Monster to choose cookie with probability . The payoff to each of Pie Monster and Cookie Monster is .

* 1. (10 points) Cookie Monster and Pie Monster both remember an agreement they made long ago: if they got in a fight that they could not resolve, Cookie Monster would win if the lights on top of 30 Rockefeller Plaza are blue, and Pie Monster would win if they are red. Both decide independently that if the lights are blue, they will go to the cookie store and if the lights are red they will go to the pie store. Before they look at 30 Rock, they know that the probability of the lights being blue is ½ and the probability of red is ½. What is the expected payoff of this coordination strategy?

They will pick (cookie, cookie) with probability half and (pie, pie) with probability half. The expected payoff is (3, 3). Given that the other player is playing this coordinated equilibrium, each player has no incentive to deviate.

* 1. (5 points) If a mixed strategy equilibrium exists, is the payoff in c) larger, smaller, or the same as the payoff in b)? Provide intuition why.

It is larger. The coordination device (the lights) eliminates the outcome that Pie Monster and Cookie Monster end up going to different places.

1. Cookie Monster decides he no longer wants to work in investment banking, so he gets a job as the assistant to the CEO of a private equity firm. The CEO is a very busy person with a lot of money. She has 5 hours of leisure per week and $5000 to spend on consumption. Cookie Monster, on the other hand, has no money and lots of leisure time. He is endowed with $10 and 20 hours of leisure per week. The utility function of the CEO is and the utility of Cookie Monster is now where is hours of leisure per week and c is consumption.
   1. (5 points) Suppose Cookie Monster gets paid wage w. Solve for the CEO’s demand for hours of labor from Cookie Monster as a function of w.

Let h be the hours of labor demanded from Cookie Monster by the CEO. The CEO solves

s.t.

Substituting in gives

* 1. (5 points) Solve for the supply of hours of labor by Cookie Monster as a function of w.

Let s be the hours of labor supplied by Cookie Monster. Cookie Monster solves

s.t.

Substituting in gives

* 1. (5 points) Solve for the equilibrium wage rate by equating Cookie Monster’s supply function with the CEO’s demand. How many hours will Cookie Monster supply to the CEO at this wage? How much money will Cookie Monster earn?

Setting supply and demand equal gives the condition

Plugging this in to the supply function gives

* 1. (5 points) Sketch an Edgeworth box in consumption-leisure space. Indicate the initial endowments (1 point) and the competitive solution (1 point). Sketch indifference curves for both the CEO and Cookie Monster through the initial endowments (1 point each) and shade the region in which there are gains from trade (1 point).

Leisure 25

Initial

Competitive

0 ` 5010 Consumption

* 1. (5 points) After beginning work for the CEO, Cookie Monster discovers that the CEO’s mood is also a function of the performance of her investment portfolio. Her utility is given by where s&p is the S&P 500 at the start of business. How does this change the answers to sections a through d?

This will have no effect on the supply or demand of labor and thus no effect on the answers in a) through d).

1. In his newly-found free time, Cookie Monster decides to start a business making caffeinated cookies to sell to his friends who work at Goldman Sachs. The total cost of making q cookies is . The demand for caffeinated cookies is
   1. (5 points) Graph the demand curve for caffeinated cookies. Label both axes.
   2. (5 points) Compute the equilibrium price, quantity, and Cookie Monster’s profits.

Find the equilibrium quantity by setting marginal revenue equal to marginal cost. Total revenue is given by and marginal revenue is . Marginal cost is q. Setting these equal gives . The equilibrium price is . Cookie monster’s profits are

* 1. (5 points) Cookie Monster finds cheaper caffeine powder to use in his cookies. His total cost function is now . Re-do b) with this new cost function. How is Cookie Monster’s profit affected by this change in costs?

Total revenue and marginal revenue are unchanged. Marginal cost is now .5 q. Setting these equal gives . The equilibrium price is . Cookie monster’s profits are Cookie Monster’s profits increase.

* 1. (10 points) To improve public health, Mayor Michael Bloomberg imposes a $25 tax on each caffeinated cookie sold in New York City. Solve for the new equilibrium price and quantity of cookies using the cost function from parts a) and b). How does this tax affect Cookie Monster’s profits? What is the tax revenue for the city from Cookie Monster’s cookie business? What is the deadweight loss from the tax?

The tax implies that the price paid by consumers is not equal to the amount received by cookie monster. Let p be the amount received by Cookie Monster for each cookie and p’=p+25 be the price faced by the consumer. Then demand is given by

Costs are unaffected. Total revenue is given by and marginal revenue is . Marginal cost is q. Setting these equal gives . The equilibrium price is . Cookie monster’s profits are Cookie monster loses $729.16 in profits. The city gets tax revenue of 25\*. The loss in consumer surplus is $243.06. The deadweight loss is $347.22.