

# LECTURE NOTES ON MICROECONOMICS

## ANALYZING MARKETS WITH BASIC CALCULUS

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### Part 5: Further topics

#### Chapter 20: Labor supply

#### Problems

(20.1) [Budget line] Give an equation for the person's budget constraint under each of the following circumstances. Use the following notation: let  $C$  denote consumption in dollars,  $H_L$  denote leisure (nonwork) time, and  $H_W$  denote work time. Also find the slope of the budget line with  $C$  on the vertical axis and  $H_L$  on the horizontal axis.

- a. Alice has 60 hours per week of total time available for work or leisure. If she works, she can earn \$15 per hour and can set her own hours. Alice has no nonlabor income.
- b. Bob has 52 weeks per year available for work or leisure. If he works, he can earn \$500 per week. He can freely choose how many weeks he works. Bob has no nonlabor income.
- c. Carla has 30 days per month available for work or leisure. If she works, she can earn \$200 per day. She can freely choose how many days she works. Carla has \$1000 per month in nonlabor income.

(20.2) [Nonlinear budget line] Draw the person's budget constraint, or describe it in words, under each of the following circumstances. Label or report the intercept on the consumption axis, the intercept on the leisure axis, and any kink point.

- a. Eva has 60 hours per week of total time available for work or leisure. If she works, she can earn \$10 per hour and can set her own hours with the following restriction: her employer will not permit her to work more than 35 hours per week.
- b. Fred has 60 hours per week of total time available for work or leisure. If he works, he can earn \$10 per hour and can set his own hours. Moreover, if he works more than 40 hours per week, he can earn "time-and-a-half" (that is, \$15 per hour) for each hour more than 40.
- c. Gigi has 60 hours per week of total time available for work or leisure. If he works, she can earn \$15 per hour at her main job and can set her own hours. However, her main job will not employ her more than 40 hours per week. If she wants to work more than 40 hours, she must take a second job that pays only \$8 per hour.
- d. Hank has 30 days per month available for work or leisure. If he works, he can earn \$50 per day. He can freely choose how many days he works. However, if he works at all, he must buy a monthly parking sticker for \$100.

(20.3) [Choosing hours of work] Suppose Walt Worker has 25 days available per month for work or leisure (nonmarket activities). Let  $H_W$  denote Walt's days of work per month and  $H_L$  denote his days of leisure per month. Let  $C$  denote his consumption, measured in dollars. Assume Walt has utility function  $U = C^{1/2} + 5H_L^{1/2}$ .

- a. Find a formula for Walt's marginal rate of substitution of leisure for consumption—that is, the slope of his indifference curve with consumption on the vertical axis and leisure on the horizontal axis.

Suppose Walt can earn \$100 per day and can choose how many days to work each month.

- b. Find an equation for Walt's budget line.
- c. What is the slope of his budget line?
- d. Compute Walt's choice of leisure days  $H_L$ , work days  $H_W$ , and consumption  $C$ .

(20.4) [Choosing hours of work] Suppose Wendy Worker has 60 hours available per week for work or leisure (nonmarket activities). Let  $H_W$  denote Wendy's hours of work per week and  $H_L$  denote her hours of leisure per week. Let  $C$  denote her consumption, measured in dollars. Assume Wendy has utility function  $U = (C-200)H_L$ .

- a. Find a formula for Wendy's marginal rate of substitution of leisure for consumption—that is, the slope of her indifference curve with consumption on the vertical axis and leisure on the horizontal axis.

Suppose Wendy can earn \$20 per hour and can choose how many hours to work each week.

- b. Find an equation for Wendy's budget line.
- c. What is the slope of her budget line?
- d. Compute Wendy's choice of leisure hours  $H_L$ , work hours  $H_W$ , and consumption  $C$ .

(20.5) [Choosing hours of work] Suppose Lisa Laborer has 60 hours of time available per week for work or leisure (nonmarket activities). Let  $H_W$  denote Lisa's hours of work per week and  $H_L$  denote her hours of leisure per week. Let  $C$  denote her consumption, measured in dollars. Assume Lisa has utility function  $U = C^2 H_L$ .

- a. Find a formula for Lisa's marginal rate of substitution of leisure for consumption—that is, the slope of her indifference curve with consumption on the vertical axis and leisure on the horizontal axis.

Suppose Lisa can earn \$10 per hour and can choose how many hours to work each week.

- b. Find an equation for Lisa's budget line.
- c. What is the slope of her budget line?
- d. Compute Lisa's choice of leisure hours  $H_L$ , work hours  $H_W$ , and consumption  $C$ .

(20.6) [Choosing hours of work with nonlabor income] Use all the information given in the previous problem about Lisa Laborer. But now assume she has \$600 in weekly nonlabor income (perhaps from investments).

- a. Lisa's budget line now has a kink. Explain why it has a kink and where the kink occurs.
- b. Compute Lisa's reservation wage, the lowest hourly wage at which she will work any hours at all. [This is the value of her marginal rate of substitution at the kink point.]
- c. Assume again that Lisa can earn \$10 per hour and can choose how many hours to work each week. Compute Lisa's choice of leisure hours  $H_L$ , work hours  $H_W$ , and consumption  $C$ .

(20.7) [Labor supply] Suppose Ed Employee has 80 hours of time available per week for work or leisure. Ed has no nonlabor income. His utility function takes the Cobb-Douglas form  $U = C^3 H_L$ , where  $H_L$  denotes his hours of leisure per week and  $C$  denotes his consumption per week, measured in dollars.

- a. Find a formula for Ed's marginal rate of substitution of leisure for consumption—that is, the slope of his indifference curve with consumption on the vertical axis and leisure on the horizontal axis.
- b. Let  $W$  denote Ed's hourly wage. Find an equation for Ed's budget line in terms of  $W$ .
- c. Prove that, given his preferences, Ed will always enjoy 20 hours of leisure every week no matter what wage he can earn.
- d. Given his preferences, which exerts a stronger effect on his choice of leisure and work hours—the income effect or the substitution effect?

(20.8) [Labor supply] True or false? Explain your answer in detail.

- a. "If Joe prefers to work more hours as his wage rises, then Joe's income effect is stronger than his substitution effect."
- b. "Nonlabor income does not affect people's labor supply because it does not affect how much they are paid for working."
- c. "If someone prefers to work the same hours no matter what the wage, an employer can take advantage of that person and pay her or him only a subsistence wage." [Hint: Assume the labor market is competitive.]

(20.9) [Reservation wage] Emily Employee has 60 hours available per week for work or leisure (nonmarket activities). Let  $H_W$  denote Emily's hours of work per week and  $H_L$  denote her hours of leisure per week. Let  $C$  denote her consumption, measured in dollars. Assume Emily has utility function  $U = H_L C^2$ .

- a. Find a formula for Emily's marginal rate of substitution of leisure for consumption—that is, the slope of her indifference curve with consumption on the vertical axis and leisure on the horizontal axis.
- b. Suppose Emily has no nonlabor income. Compute her reservation wage—the lowest wage at which she will work at all.
- c. Now suppose Emily has \$600 per week of nonlabor income. Compute her reservation wage.
- d. Now suppose Emily has \$1800 per week of nonlabor income. Compute her reservation wage.

[end of problem set]