1. (6 points) Consider the following data for July 2000 to answer the questions that follow:

| Civilian noninstitutional population | 209,727 |
| Civilian labor force                  | 140,399 |
| Employed                               | 134,749 |
| Not in labor force                     | 69,329  |

a. What is the labor force participation rate?

\[
\frac{140,399}{209,727} = 66.9\%
\]

b. What is the unemployment rate?

\[
\frac{(140,399 - 134,749)}{140,399} = 4.0\%
\]

2. (6 points) Between 1980 and 1998, average nominal hourly earnings in the U.S. grew from $6.66 to $12.77. At the same time, the real hourly wage (in 1982 dollars) fell from $7.78 to $7.75.

Based on the above information:

a. what was the CPI in 1980?

\[
CPI_{80} = 100 \times \frac{6.66}{7.78} = 85.6
\]

b. what was the CPI in 1998?

\[
CPI_{98} = 100 \times \frac{12.77}{7.75} = 164.8
\]

3. (9 points) The output of workers at a factory depends on the number of supervisors hired (see below). The factory sells its output for $2.00 each, it hires 50 production workers at a wage of $100 per day, and needs to decide how many supervisors to hire. The daily wage of supervisors is $350 but output rises as more supervisors are hired, as shown below.

<table>
<thead>
<tr>
<th>No. of supervisors</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output per day</td>
<td>1,500</td>
<td>1,800</td>
<td>2,000</td>
<td>2,100</td>
<td>2,150</td>
<td>2,175</td>
</tr>
</tbody>
</table>

a. What is the marginal product of the third supervisor? 200 units of output

b. What is the marginal revenue product of the third supervisor? $400 = P \times MP

c. How many supervisors should the firm hire to maximize profits?

3 (until 3rd supervisor, MRP > W; with 4th, MRP < W)
4. (6 points) Suppose that the MP of labor and capital are 10 and 30, and that their respective prices are 5 and 20. Given the current combination of labor and capital, how should the firm adjust its mixture of labor and capital? Briefly describe what criteria you used to determine your answer.

Since \( ME_l / MP_l = 5/10 = .5 \) and \( ME_k / P_k = 20/30 = .67 \), it takes \$.50 to increase output by one unit with labor, but \$.67 to increase output by one unit with capital. Consequently, it would be more cost effective to use more labor and less capital to produce output. As labor increases, its MP falls and as capital decreases its MP rises. Eventually, the cost per unit of output \( (ME/MP) \) will become equal for the two inputs.

5. (8 points) Suppose that the federal government passes federal legislation that mandates that the employer of any worker contribute $500 annually to a “private social security account”.

   a. Explain how and why this legislation would affect the firm’s choice of hours per worker and number of workers.

   **This $500 charge is a quasi-fixed cost. If the firm was minimizing costs initially, then \( ME_M / MP_M = ME_H / MP_H \) where ME is the marginal expense of an additional worker (M) or an additional hour of work for all existing workers (H), and MP is the marginal product of an additional worker or an additional hour. With the increase in the quasi-fixed costs, \( ME_M \) rises and it becomes more cost effective to switch to more hours per worker (H) and fewer workers until the ratios become equal again.**

   b. Suppose instead that the rule was that the employer contribute 2% of the worker’s pay to a “private social security account”. Explain how and why this would have a different effect on the mix of workers and hours per worker than the program described above.

   **In this case, both \( ME_M \) and \( ME_H \) increase, but there is a larger percentage increase in the \( ME_H \) since the quasi-fixed component of \( ME_M \) is unaffected. Following the rule for optimization given in (a), this will lead the firm to use fewer hours but more workers to bring the ratios back into equality.**

6a. (15 points) Distinguish between general and specific training.

   **General training increases a worker’s MP at all firms. Specific training increases a worker’s MP only at the firm that provides the training.**

   b. In one sentence, explain why a firm will usually not pay for general training.

   **A firm will not pay for general training because once the training is complete the firm cannot pay less than the worker’s MP to recoup training costs or the worker will leave to receive pay equal to his full MP at other firms.**

   c. What guarantee would a firm need from the worker in order that the firm be willing to pay for general training.

   **The firm would need to have the worker sign a contract indicating that, once the training is complete, he will not leave, or that the worker will reimburse the firm for the training costs if he leaves.**
d. In one sentence, explain why a firm will usually want to defer pay when it provides an employee with specific training.

*If a firm defers pay, it reduces the likelihood that a quitter will accept a job offer and reduces the likelihood that a person will quit after the training is complete.*

e. In one sentence, explain why a worker may be reluctant to accept an offer with deferred pay.

*A worker may be reluctant to accept an offer with deferred pay because the firm may go bankrupt or break its promise to pay above what the worker can earn elsewhere after the training is complete.*

7a. (30 points) Draw the budget constraint for the unemployment insurance system for the person described below (the more numeric detail the better). Prior to the layoff the person was working 40 hours per week at a wage rate of $20 per hour and has no non-labor income. Upon being laid off, the worker will receives an unemployment insurance check that replaces 50% of her prior earnings. If she accepts a new job and earns up to 1/2 of her prior earnings, the unemployment insurance check is not reduced. If she accepts a new job and earns more than 1/2 of prior earnings, the unemployment insurance check is eliminated. Assume that there is a maximum 102 hours per week of labor (or leisure).

![Budget Constraint Graph]

b. Refer to your budget constraint above to describe the range of hours worked that would be inconsistent with utility maximization. Why would working in this range be “irrational”.

*The person would not work between 20 and 40 hours per week (leisure of 62 to 82) because this range of hours would give less total income and less leisure than working 20 hours per week. Put differently, the budget constraint between 82 and 102 hours of leisure will always generate a higher level of utility (indifference curve) than the budget constraint between 62 and 82 hours of leisure.*
c. Suppose that the UI program described in (a) is changed so that benefits are reduced by $1 for every $2 of earnings. Hence, once a person’s earnings equals her pre-unemployment level, the benefit is reduced to zero (it can’t be negative). In a separate diagram from that drawn for part (a), illustrate how this change will affect the budget constraint relative to the one you drew for part (a).

![Graph showing budget constraint]

d. Compared to the program in (a), will the program in (c) increase or decrease the probability that a person currently collecting unemployment insurance will begin employment? Explain.

*Program in (a) gives budget constraint ABCE; Program in (c) gives ADE. The probability that a worker will accept employment is greater with the old program since the reward for the first hour of work (the slope of the budget constraint) is greater ($20 instead of $10) and it is more likely that the wage will exceed the reservation wage. However, unlike the old program, some people in the new program will choose to work between 20 and 40 hours.*
8. (30 points) Below is a description of the current State Teacher Retirement System of Ohio pension benefit.

**STRS Salary-related benefit**

The annual salary-related benefit (a life annuity at retirement) is calculated by multiplying your first 30 years of service credit by 2.2% of the final average salary (average of your three highest years of Ohio public earnings).

The 31st year of contributing service credit is multiplied by 2.5% of the final average salary. An additional one-tenth of a percent is added to the calculation for every year of contributing service over 31 years (2.6% for the 32nd year, 2.7% for the 33rd year and so on) until 100% of the final average salary is reached.

Consider a person with 30 years of service at age 55 and a final average salary of $100,000. Assume life expectancy of 85.

Assuming that final average salary does not change and an interest rate of 0%, how does postponing retirement from age 55 to age 56 affect:

a. the PV of the pension benefit (give a numerical value and show your calculation).

At age 55, the person’s annual benefit would be 30*.022*100,000=$66,000. The PV of $66,000 for 30 remaining years of life is $66,000*30=$1,980,000.

At age 56, the person’s annual benefit would be (30*.022+.025)*100,000=68,500. The PV of $68,500 for 29 remaining years of life is $68,500*29=1,986,500

**Consequently, postponing retirement from age 55 to 56 increases the PV of pension benefits by $6,500.**

b. the PV of lifetime earnings (give a numerical value and show your calculation).

At age 55 retirement, the PV of the person’s remaining lifetime earnings would be 0.

At age 56 retirement, the PV of the person’s remaining life earnings would be $100,000.

**The increase in the PV of lifetime earnings from postponing retirement from age 55 to age 56 is $100,000.**

When Professor Even arrived at Miami University, all years were credited with 2% (not 2.2% as now) per year of service. The credit did not increase beyond age 30.
c. For the person described above, draw budget constraints for a retirement age that begins at age 55 and may be as high as 75 for the “new” and “old” systems without providing numerical detail.

\[\text{PV of Lifetime Income} \]

\[\begin{array}{c}
\text{new} \\
\text{old}
\end{array} \]

75 Retirement age 55


d. For a person that retired at age 55 under the old program, is it possible to say whether the change would be more likely to cause an earlier or later retirement date? Explain with reference to income and/or substitution effects (no need to draw more diagrams ... just provide a verbal description of each effect).

At age 55, the new system generates higher benefits (2.2*30 instead of 2.0*30) and it generates larger increment in benefits for postponing retirement by a year (2.5% for an additional year instead of 2.0). The former effect shifts the budget constraint up, the latter effect steepens the budget constraint. The effect on retirement age is ambiguous. The wealth effect is that the person has greater wealth under the new plan at age 55 and would retire sooner. The substitution effect is that the monetary reward for retiring later has increased so the person retires later.

e. An important complication that we have not discussed in our analysis of pension benefit formulas is that postponing retirement by a year will affect the “final average salary” which is based on the highest three years of earnings. Given that higher inflation is generally associated with higher nominal wage growth, how would the slow down of inflation that has occurred over the past few decades affect the incentive to retire? Explain by describing the effect on the budget constraints you drew above.
During periods of high inflation, nominal earnings growth is higher and a person’s final average salary will increase more when retirement is postponed. As a consequence, during less inflationary times, the increase in the annual benefit from postponing retirement is smaller, the lifetime budget constraint becomes flatter, and the substitution effect is to retire sooner.

f. Explain how the recent switch to defined contribution plans would affect the incentive to retire.

In defined benefit plans, a benefit is paid from retirement age until death. The PV of benefits will eventually diminish as retirement is postponed because the number of years that the person collects benefits drops. In defined contribution plans, the person receives a lump sum upon retirement that is equal to the compounded value of all contributions. The PV of a DC plan can only grow as a person postpones retirement. Consequently, the financial reward to postponing retirement is greater in a DC than a DB plan and, assuming no wealth effects, people will retire later.