ECO 120-04
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Assignment 6 Solutions

Part A: BLS definitions

The Bureau of Labor Statistics (BLS) surveys people aged 16 or older and applies these definitions:

- *Employed*: Those who performed any work (including self-employment or on a family farm).
- *Unemployed*: Those who had no employment, were available for employment, and looked for a job in the preceding four weeks.
- *Labor force*: The sum of employed and unemployed people.
- *Unemployment rate*: The number unemployed as a percent of the labor force.
- *Labor force participation rate*: The labor force as a percent of the population.

Part B: Entering and exiting the labor force

For this section, please

- use four digits after the decimal in your answers,
- specify units, such as percent (%) or percentage points (p.p.) as applicable, and
- use the data in the following table and the BLS definitions above.

BLS data for the U.S. in February 2020	
Classification	People, millions
Employed	158.8
Unemployed	5.8
Working-age population	259.6

1. Write the formula for *the labor force participation rate* as a function of *employment*, *unemployment*, and *the working-age population*.

   $$\text{labor force participation rate} = \frac{\text{employment + unemployment}}{\text{the working-age population}}.$$

2. What was the labor force participation rate in February 2020?

$$\text{labor force participation rate} = \frac{158.8 \text{ M people} + 5.8 \text{ M people}}{259.6 \text{ M people}} = \frac{164.6}{259.6} = 0.6341 = 63.41\%.$$

3. What was the unemployment rate in February 2020?

$$\text{unemployment rate} = \frac{\text{unemployment}}{\text{the labor force}} = \frac{\text{unemployment}}{\text{employment} + \text{unemployment}}.$$

$$\text{unemployment rate} = \frac{5.8 \text{ M people}}{158.8 \text{ M people} + 5.8 \text{ M people}} = \frac{5.8}{164.6} = 0.0352 = 3.52\%.$$

4. Suppose that in March 2020, 1 million unemployed people quit looking for a job, and the number of employed people stayed the same as in February 2020.

a) What would be the unemployment rate in March 2020?

$$\text{unemployment rate} = \frac{4.8 \text{ M people}}{158.8 \text{ M people} + 4.8 \text{ M people}} = \frac{4.8}{163.6} = 0.0293 = 2.93\%.$$

b) What was the change in the unemployment rate from February 2020 to March 2020?

$$\begin{aligned} \text{change} &= x_{\text{final}} - x_{\text{initial}} \\ \text{change in unemp. rate} &= \text{unemp. rate}_{\text{2020-Mar}} - \text{unemp. rate}_{\text{2020-Feb}} \\ &= 2.93\% - 3.52\% = -0.59 \text{ p.p.} \end{aligned}$$

Suppose we mistakenly wrote that the unemployment rate changed by −0.59%; we wrote units of percent instead of percentage points (p.p.). Then $\text{unemp rate}_{\text{2020-Mar}} = (100\% - 0.59\%) \times \text{unemp rate}_{\text{2020-Feb}} = (1 - 0.0059) \times 3.52\% = 3.49\%$. This isn't the true value.

Here, a decrease in the unemployment rate of 0.59 percentage points instead conveys this: the prior rate, 3.52% declined by 0.59 percentage *points*. Doing this simpler arithmetic, we find that $\text{unemp rate}_{\text{2020-Mar}} = 3.52\% - 0.59 \text{ p.p.} = 2.93\%$, which is the true value.

c) Why did the unemployment rate change without any change in employment?

People who switch between employment and unemployment obviously affect the rate.

In this case, however, unemployed people decided to leave the labor force altogether, which affected the unemployment rate.

5. *Now instead suppose* that in March 2020, the number of unemployed people remained the same as in February 2020, while 5 million people quit their jobs to be stay-at-home parents.

a) In this case, what would be the unemployment rate in March 2020? Please specify units.

$$\text{unemp. rate}_{\text{2020-Mar}} = \frac{5.8 \text{ M people}}{153.8 \text{ M people} + 5.8 \text{ M people}} = 4.10\%$$

b) What was the change in the unemployment rate from February 2020 to March 2020? Please specify units.

$$\text{change in unemployment rate} = 4.10\% - 3.52\% = 0.57 \text{ p.p.}$$

c) Why did the unemployment rate change without any change in unemployment?

> Employed people left the labor force. As a result, unemployed people constitute a greater share of the labor force.

Part C: Production and output

For this section, please use the fictional data below. *Please specify units for each answer.*

Year	Carrots		Onions	
	Price ($/ton)	Output (tons)	Price ($/ton)	Output (tons)
2019	2	10	3	15
2020	3	8	4	11

1. What was nominal GDP in 2019?

$$\begin{aligned}\text{nom. gdp}_{2019} &= p_{2019}^{\text{carrots}} \times y_{2019}^{\text{carrots}} + p_{2019}^{\text{onions}} \times y_{2019}^{\text{onions}} \\ &= \frac{\$2}{\text{ton of carrots}} \times 10 \text{ tons of carrots} + \frac{\$3}{\text{ton of onions}} \times 15 \text{ tons of onions} = \$65\end{aligned}$$

2. What was nominal GDP in 2020?

$$\begin{aligned}\text{nom. gdp}_{2020} &= p_{2020}^{\text{carrots}} \times y_{2020}^{\text{carrots}} + p_{2020}^{\text{onions}} \times y_{2020}^{\text{onions}} \\ &= \frac{\$3}{\text{ton of carrots}} \times 8 \text{ tons of carrots} + \frac{\$4}{\text{ton of onions}} \times 11 \text{ tons of onions} = \$68\end{aligned}$$

3. What was the percent change in nominal GDP from 2019 to 2020?

$$\%\,\Delta \text{ = percent change} = \frac{x_{\text{final}} - x_{\text{initial}}}{x_{\text{initial}}}$$

$$\%\,\Delta\,(\text{nom. gdp}) = \%\text{ change in nom. gdp} = \frac{\text{nom. gdp}_{2020} - \text{nom. gdp}_{2019}}{\text{nom. gdp}_{2019}}$$

$$= \frac{\$68 - \$65}{\$65} = 0.0462 = 0.0462 \times 100\% = 4.62\%$$

4. For this question, please use 2019 as the base year.

a) What was real GDP in 2019?

Complete answer: \$65.

To find real GDP, we use prices from the base year and output from the year of interest. After all, we're trying to measure of output for the year of interest by controlling for prices.

$$\begin{aligned}\text{real gdp}_{2019} &= p^{\text{carrots}}_{\textbf{base year}} \times y^{\text{carrots}}_{2019} + p^{\text{onions}}_{\textbf{base year}} \times y^{\text{onions}}_{2019} \\ &= p^{\text{carrots}}_{\textbf{2019}} \times y^{\text{carrots}}_{2019} + p^{\text{onions}}_{\textbf{2019}} \times y^{\text{onions}}_{2019} \\ &= \frac{\$2}{\text{ton of carrots}} \times 10 \text{ tons of carrots} + \frac{\$3}{\text{ton of onions}} \times 15 \text{ tons of onions} = \$65\end{aligned}$$

Real GDP for the base year is always the same as nominal GDP for the base year.

b) What was real GDP in 2020?

Complete answer: \$49.

$$\begin{aligned}\text{real gdp}_{2020} &= p^{\text{carrots}}_{\textbf{base year}} \times y^{\text{carrots}}_{2020} + p^{\text{onions}}_{\textbf{base year}} \times y^{\text{onions}}_{2020} \\ &= p^{\text{carrots}}_{\textbf{2019}} \times y^{\text{carrots}}_{2020} + p^{\text{onions}}_{\textbf{2019}} \times y^{\text{onions}}_{2020} \\ &= \frac{\$2}{\text{ton of carrots}} \times 8 \text{ tons of carrots} + \frac{\$3}{\text{ton of onions}} \times 11 \text{ tons of onions} = \$49\end{aligned}$$

c) What was the percent change in real GDP from 2019 to 2020?

Complete answer: −24.61%

$$\%\,\Delta\,(\text{real gdp}) = \frac{\text{real gdp}_{2020} - \text{real gdp}_{2019}}{\text{real gdp}_{2019}}$$

$$= \frac{\$49 - \$65}{\$65} = -0.2461 = -0.2461 \times 100\% = -24.61\%$$

5. For this question, please use 2020 as the base year.

a) What was real GDP in 2019?

> *Complete answer:* \$90.
>
> $$\begin{aligned}\text{real gdp}_{2019} &= p^{\text{carrots}}_{\textbf{base year}} \times y^{\text{carrots}}_{2019} + p^{\text{onions}}_{\textbf{base year}} \times y^{\text{onions}}_{2019} \\ &= p^{\text{carrots}}_{\textbf{2020}} \times y^{\text{carrots}}_{2019} + p^{\text{onions}}_{\textbf{2020}} \times y^{\text{onions}}_{2019} \\ &= \frac{\$3}{\text{ton of carrots}} \times 10 \text{ tons of carrots} + \frac{\$4}{\text{ton of onions}} \times 15 \text{ tons of onions} = \$90\end{aligned}$$

b) What was real GDP in 2020?

> *Complete answer:* \$68.
>
> $$\begin{aligned}\text{real gdp}_{2020} &= p^{\text{carrots}}_{\textbf{base year}} \times y^{\text{carrots}}_{2020} + p^{\text{onions}}_{\textbf{base year}} \times y^{\text{onions}}_{2020} \\ &= p^{\text{carrots}}_{\textbf{2020}} \times y^{\text{carrots}}_{2020} + p^{\text{onions}}_{\textbf{2020}} \times y^{\text{onions}}_{2020} \\ &= \frac{\$3}{\text{ton of carrots}} \times 8 \text{ tons of carrots} + \frac{\$4}{\text{ton of onions}} \times 11 \text{ tons of onions} = \$68\end{aligned}$$
>
> Again, real GDP for the base year is always the same as nominal GDP for the base year.

c) What was the percent change in real GDP from 2019 to 2020?

> *Complete answer:* −24.44%
>
> $$\begin{aligned}\%\,\Delta\,(\text{real gdp}) &= \frac{\text{real gdp}_{2020} - \text{real gdp}_{2019}}{\text{real gdp}_{2019}} \\ &= \frac{\$68 - \$90}{\$90} = -0.2444 = -0.2444 \times 100\% = -24.44\%\end{aligned}$$

6. Why is the percent change in nominal GDP so different than the percent change in real GDP?

> The price of carrots increased by 50%. The price of onions increased by 33%. This inflation made the change in output larger in nominal terms than it was in real terms.