Problem 1. Consider the following table:

	Firm 1	Firm 2	Firm 3	Firm 4
Sales Revenue ($)	540,000	330,000	230,000	385,000
Cost of Intermediate Goods ($)	200,000	150,000	130,000	80,000
Wages, Interest, Rent Paid to Households ($)	300,000	180,000	135,000	90,000

- Firm 1 sells its products to households, buys intermediates from Firm 2.
- Firm 2 sells its products to Firm 1 and Firm 3, buys intermediates from Firm 3.
- Firm 3 sells its products to Firm 2 and Firm 4, buys intermediates from Firm 2.
- Firm 4 sells its products to households, buys intermediates from Firm 3.

Determine the following values:

(a) Value of final goods sold by Firm 1

(b) Value of final goods sold by Firm 2

(c) Value of final goods sold by Firm 3

(d) Value of final goods sold by Firm 4

(e) Nominal GDP as the sum of the market values of the all final goods

Answer 1.

(a) Firm 1 is selling to households, i.e. is selling a final product. So their revenue is all from final goods. Thus the answer is \$540,000.

(b) Firm 2 is selling intermediate goods to Firm 1, therefore not selling any final goods.

(c) Firm 3 is selling intermediate goods to Firm 2 and Firm 3, therefore not selling any final goods.

(d) Firm 4 is selling to households, i.e. is selling a final product. So their revenue is all from final goods. Thus the answer is \$385,000.

(e) Nominal GDP is therefore $\$540,000 + \$385,000 = \$925,000$.

Important!!!!!!11 The total revenue from the sale of (i.e. value of) final goods and services is equivalent to total expenditure on final goods and services. This is because revenue is generated when someone is spending money for those final goods. So we have an equivalence:

NGDP = value of final goods and services = expenditure on final goods and services.

Problem 2. Consider the same table:

	Firm 1	Firm 2	Firm 3	Firm 4
Sales Revenue ($)	540,000	330,000	230,000	385,000
Cost of Intermediate Goods ($)	200,000	150,000	130,000	80,000
Wages, Interest, Rent Paid to Households ($)	300,000	180,000	135,000	90,000

- Firm 1 sells its products to households, buys intermediates from Firm 2.
- Firm 2 sells its products to Firm 1 and Firm 3, buys intermediates from Firm 3.
- Firm 3 sells its products to Firm 2 and Firm 4, buys intermediates from Firm 2.
- Firm 4 sells its products to households, buys intermediates from Firm 3.

Determine the following values:

(a) Value added by Firm 1

(b) Value added by Firm 2

(c) Value added by Firm 3

(d) Value added by Firm 4

(e) Nominal GDP as the sum of the values added

Answer 2.

(a) Firm 1 buys \$200,000 worth of intermediate goods, makes stuff with those intermediate goods, and sells that stuff for \$540,000. So they have *added the value* of

$$\$540,000 - \$200,000 = \$340,000$$

to the intermediate goods that they started with.

(b) $330,000 - 150,000 = 180,000$

(c) $230,000 - 130,000 = 100,000$

(d) $385,000 - 80,000 = 305,000$

(e) Sum the values added for nominal GDP:

$$340,000 + 180,000 + 100,000 + 305,000 = 925,000.$$

So now we have shown that

$$\begin{aligned} \text{NGDP} &= \text{value of final goods and services} \\ &= \text{expenditure on final goods and services} \\ &= \text{sum of values added.} \end{aligned}$$

Problem 3. Consider the same table:

	Firm 1	Firm 2	Firm 3	Firm 4
Sales Revenue ($)	540,000	330,000	230,000	385,000
Cost of Intermediate Goods ($)	200,000	150,000	130,000	80,000
Wages, Interest, Rent Paid to Households ($)	300,000	180,000	135,000	90,000

- Firm 1 sells its products to households, buys intermediates from Firm 2.
- Firm 2 sells its products to Firm 1 and Firm 3, buys intermediates from Firm 3.
- Firm 3 sells its products to Firm 2 and Firm 4, buys intermediates from Firm 2.
- Firm 4 sells its products to households, buys intermediates from Firm 3.

Determine the following values:

(a) Income generated by Firm 1
(b) Income generated by Firm 2
(c) Income generated by Firm 3
(d) Income generated by Firm 4
(e) Nominal GDP as the total income generated

Answer 3. The (factor) income generated by a firm is the wages received by its employees; plus the interest paid to the bank; plus the rent paid to households; plus the firm's own profit.

$$\begin{aligned} \textit{Profit} &= \textit{Revenue} - \textit{All Costs} \\ \implies \textit{Income} &= (\textit{Revenue} - \textit{All Costs}) + (\textit{Wages, Interest, Rent Paid to Households}) \\ &= \textit{Revenue} - \textit{Cost of Intermediate Goods} \\ &= \textit{Value Added}. \end{aligned}$$

So the income generated by the firm is exactly the same as their value added. Therefore the answers are the same as in problem 2.

(a) $540,000 - 200,000 = 340,000$

(b) $330,000 - 150,000 = 180,000$.

(c) $230,000 - 130,000 = 100,000$

(d) $385,000 - 80,000 = 305,000$

(e) Sum the incomes generated by each firm to find nominal GDP:

$$340,000 + 180,000 + 100,000 + 305,000 = 925,000.$$

Equivalent Statements of NGDP

Combining the three exercises, we have seen that

$$\begin{aligned}\text{Nominal GDP} &= \text{sum of value of final goods and services}\\ &= \text{sum of expenditure on final goods and services}\\ &= \text{sum of values added}\\ &= \text{sum of factor income.}\end{aligned}$$

We've touched the least on the expenditure aspect. This is because we'll be seeing a lot more of it later on. Make sure you know the difference between *factor* income and *household* income, 'cuz they ain't the same thing.

Problem 4. A used car dealer purchased my 1992 Ford Tempo for $1,000. He paid a worker $200 to wash it. He purchased four tires for a total of $400 to replace the existing tires on the car. He then sold the car for $4,000. All these economic activities took place in 2017. What was the used car dealer's value added in 2017?

Answer 4. Value added is the revenue minus the cost of intermediate goods. In this case, buying the used car constitutes the cost of an intermediate good, as do the new tires. The cost of the car wash, however, constitutes a wage since he payed an employee to wash it. So the value added is

$$4,000 - (1,000 + 400) = 2,600.$$

This was the used car dealer's contribution to 2016 GDP.

Problem 5. Here are Mrs. Baker's revenue and expenses for 2016:

- Revenue from sale of bread to customers: \$65,000
- Cost of materials (such as sugar, yeast, baking soda, etc): \$15,000
- Wages paid: \$20,000
- Rent paid: \$10,000
- Interest paid: 0

Find Mrs. Baker's contribution to 2016 GDP and find her profit in 2016.

Answer 5. Contribution to GDP, as we showed earlier, is the value added:

$$65,000 - (15,000) = 50,000.$$

Her profit is revenue minus all costs:

$$65,000 - (15,000 + 20,000 + 10,000) = 20,000.$$

Problem 6. Which of the following are included in 2015 GDP?

(a) We imported $10 million worth of Italian wine in 2015.

(b) We exported $20 million worth of tomatoes to Europe in 2015.

(c) You fixed your uncle's neighbor's brother's ex-wife's garage door for $75 in 2015.

(d) The computers that Dell Corporation produced in 2015 that it could not sell.

(e) GM sold some cars in 2015 that it had produced in 2014.

(f) Dad sold his old lawn mower in a garage sale in 2015.

(g) The cost of a freeway overpass built by the government in 2015.

(h) The salaries paid to teachers in public schools in 2015.

Answer 6.

(a) Nope. Not produced domestically.

(b) Yep. Produced domestically.

(c) Yeah. You were paid $75 for your service.

(d) Oui. Produced domestically and intended for market sale.

(e) Nein. Not produced in 2016.

(f) Nyet. Sale of used or secondhand goods are not counted towards GDP because nothing new was produced.

(g) Yahuh. Government produced goods and services are included at the cost of providing them.

(h) Affirmative. Since it's a public school, it is in essence a government service.

Problem 7. Ivan is a real estate investor. He flips homes—he buys undervalued homes and sells them at a higher price later to make a profit out of the price differential (these kind of people are called flippers). In May 2016 he bought a house built in 1997 for $1,000,000 and sold it two months later for $1,200,000. Not bad. The real estate agent got 6% of the sale price as her commission. As a result of these activities the 2016 GDP increased by how much?

Answer 7. Ivan does not purchase any new paint or make any other improvements to the house—otherwise we would have been told the cost of, say, paint, or a new kitchen sink—so we cannot talk about value added. In this case, the house is treated like an asset, and its appreciation in value is a **captal gain**, due entirely to changes in the housing market, and therefore does not count toward GDP.

So the only way this affects GDP is through the service the real estate agent provides. In particular, the value of the real estate agent's service is

$$1,200,000 \times 0.06 = 72,000.$$

Problem 8. The U.S. government treats the goods produced by a firm in a year that are not sold in that year as increases in inventories and includes them in that year's GDP at market prices. In other words, the government assumes that the firm itself buys those goods for future resale. With that in mind, state whether the following are true or false.

(a) Any good produced in a year will be included in that year's GDP.

(b) Any good produced in a year will be included in that year's GDP, except those produced by households for household consumption.

(c) Any good produced and sold in a year will be included in that year's GDP.

(d) Any good produced and sold in a year will be included in that year's GDP, except those produced by firms that are not sold.

(e) Any good sold in a year will be included in that year's GDP.

(f) Any service sold in a year will be included in that year's GDP.

Answer 8.

(a) False. I cooked a frozen pizza last night—ate the entire thing myself because that's how I roll. Technically, I added value to that frozen pizza by cooking it—I produced a cooked pizza—but the value of that cooked pizza is not included in GDP because it's a household good—I had no intention of selling the pizza after cooking it because you better believe I'm eating the whole thing.

For a more sane example, consider someone who likes woodworking and builds a rocking chair for Granny. The chair is produced, but it's not intended for sale, and therefore is not included in GDP—it is a household good.

(b) True.

(c) True, including intermediate goods—but intermediate goods are *implicitly* included in the prices of their final goods, so we don't directly add them to GDP.

(d) False. If the good is produced and was intended to be sold, then any unsold inventories will be "bought" by the firm itself, thereby counting towards GDP.

(e) False. You can sell a good produced last year and it won't count towards this year's GDP.

(f) True. A service is produced when it is sold: think haircuts. There are no unsold services.

Problem 9. If the price of a product decreases with the nominal wage unchanged, the firm producing that product will want to hire fewer workers. Which of the following is true?

(a) This will be represented as a movement along the demand-for-labor function.

(b) This will be represented as a leftward shift in the demand-for-labor function.

Answer 9. P changing with W constant means W/P changes. Since W/P is the variable on the vertical axis of the labor market graph, it means we are talking about a movement along the curve.

If prices and wages are fully flexible, however, then the wage will change by the same percent that P changes by because the economy has to go back to equilibrium, which is at a specific real wage.

Problem 10. Consider the table below, where the base year is 1984:

Year	Good 1		Good 2		Good 3	
	P	Q	P	Q	P	Q
1984	$20.00	2	$30.00	5	$10.00	6
2006	$40.00	4	$60.00	7	$20.00	8
2018	$51.00	4	$72.00	7	$23.00	8

Calculate the following:

(a) Consumer price index in 1984

(b) Consumer price index in 2006

(c) Consumer price index in 2018

Answer 10. The point of CPI is to compare changes in the price level of *a bundle of goods that consumers might typically buy.* (Contrast this to the GDP deflator, which includes *everything* produced in the economy, e.g. helicopters.)

To calculate, hold *quantities* fixed at base year quantities (a *fixed basket of goods*), but allow prices to change. Then compare the cost of that fixed basket to its base year cost:

$$CPI_{year} = \frac{\text{cost of fixed basket in year}}{\text{cost of fixed basket in base year}} \times 100.$$

Thus we'll assume a fixed basket of 2, 5, and 6. The base year cost of the basket is

$$CPI_{1984} = (\$20 \times 2) + (\$30 \times 5) + (\$10 \times 6) = \$250.$$

Now compare this to the other years' basket costs.

(a) $CPI_{1984} = \dfrac{(\$20 \times 2) + (\$30 \times 5) + (\$10 \times 6)}{(\$20 \times 2) + (\$30 \times 5) + (\$10 \times 6)} \times 100 = \dfrac{250}{250} \times 100 = 100$

(b) $CPI_{2006} = \dfrac{(\$40 \times 2) + (\$60 \times 5) + (\$20 \times 6)}{(\$20 \times 2) + (\$30 \times 5) + (\$10 \times 6)} \times 100 = \dfrac{500}{250} \times 100 = 200$

(c) $CPI_{2018} = \dfrac{(\$51 \times 2) + (\$72 \times 5) + (\$23 \times 6)}{(\$20 \times 2) + (\$30 \times 5) + (\$10 \times 6)} \times 100 = \dfrac{600}{250} \times 100 = 240$

Problem 11. *True or False?* If the amount of physical capital increases, demand for labor will increase if capital is substitute for labor.

Answer 11. *False.* If capital is a substitute for labor, then labor can be replaced with machines (hence the word substitute), and therefore there is less demand for workers.

Problem 12. *True or False?* If a labor-saving technological progress takes place, demand for labor will shift to the left.

Answer 12. *True.* Labor-saving technological progress means the same amount of stuff can be produced with fewer workers. Hence the demand for workers falls. This means the demand curve for labor shifts to the left.

Problem 13. *True or False?* An increase in the amount of complementary capital will cause a movement along the demand-for-labor function.

Answer 13. *False.* Complementary capital means the capital makes workers even more productive, i.e. their MPL increases. This means the entire labor demand curve will shift to the right as firms want to hire more workers now that they're more productive.