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 intermediate goods from Firm 2.
- Firm 2 sells its products to Firm 1 and Firm 3, buys intermediate goods from Firm 3.
- Firm 3 sells its products to Firm 2 and Firm 4, buys intermediate goods from Firm 2.
- Firm 4 sells its products to households, buys intermediate goods 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, so they are not selling any final goods.

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

(d) 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 \$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:

$$\text{NGDP} = \text{value of final goods and services} = \text{expenditure on final goods and services.}$$

Reminder. Smartsite hates dollar signs, commas, and decimal places. I'm using them here sometimes for purposes of exposition, but don't use them when you actually submit the homework yourself.

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

Data for Islandia

	Haircuts		Coconuts Produced and sold by firms in Current Year		Coconuts Produced but not sold by firms in Current Year	Pineapples Produced and sold by firms in Current Year		Leftover Pineapples from previous year's production by firms sold in Current Year	Baskets weaved by households for their own use in Current year		Baskets weaved by households and sold to others in Current year		Pineapples imported from the neighboring island country in Current year	
Year	P	Q	P	Q	Q	P	Q		P	Q	P	Q	P	Q
2010	$10	102	$2.00	173	27	$ 1.00	100	20	$50.00	68	$50.00	75	$1.00	16
2011	$11	104	$2.00	203	1.75	$ 1.50	120	22	$55.00	70	$55.00	84	$1.50	16
2012	$11	106	$3.00	205	2	$ 1.75	140	26	$55.00	89	$55.00	91	$1.75	17
2013	$12	107	$3.10	210	0	$ 2.00	140	29	$56.00	90	$56.00	104	$2.00	19

Let 2011 be the base year. Calculate the following values:

(a) Islandia's nominal GDP in 2012

(b) Islandia's real GDP in 2013

(c) Islandia's GDP deflator in 2010

Answer 4.

(a) Sum the price times quantity for each qualifying good. To quality for inclusion in GDP, it must satisfy these criteria:

- a final good
- produced in this country
- produced in this year
- that was intended on being sold in the market.

$$[11 \times 106] + [3 \times (205 + 2)] + [1.75 \times 140] + [55 \times 91] = 7037.$$

(b) To find real GDP in 2013, multiply relevant 2013 quantities by base year (2011) prices:

$$[11 \times 107] + [2.00 \times 210] + [1.5 \times 140] + [55 \times 104] = 7527.$$

(c) The GDP deflator in 2010 requires both real and nominal GDP:

$$NGDP = [10 \times 102] + [2.00 \times (173 + 27)] + [1 \times 100] + [50 \times 75] = 5270,$$
$$RGDP = [11 \times 102] + [2.00 \times (173 + 27)] + [1.50 \times 100] + [55 \times 75] = 5797$$
$$\implies \quad GDP\ Deflator = \frac{5270}{5797} \times 100 \approx 90.91.$$

Problem 5. 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 2016. What was the used car dealer's value added in 2016?

Answer 5. 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 6. Here is 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 6. 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 7. 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 7.

(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 8. 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 8. 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 9. *True or false.* Nominal GDP represents three things at the same time:

- The market value of all the final goods and services produced in that year (and intended for market sale).
- Aggregate expenditure on those goods and services.
- Aggregate income earned by the factors of production that produced those goods and services.

Answer 9. True, as discussed earlier. Also the sum of values added for *all* goods and services, final and intermediate.

Problem 10. 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 10.

(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 and thus counts towards that year's 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.

GDP Deflator

Recall from last week: if we use 2005 as the base year, and all prices in 2006 are 5% higher than in 2005, then the GDP deflator in 2006 will be 105. Now suppose that prices in 2007 are 5% higher than they were in 2006. Will the GDP deflator be 110 or something else?

From last time, we have

$$P_1^{2006} = 1.05P_1^{2005} \quad and \quad P_1^{2006} = 1.05P_1^{2005}.$$

We have a similar relationship among prices in 2006 and 2007:

$$P_1^{2007} = 1.05P_1^{2006} \quad and \quad P_1^{2007} = 1.05P_1^{2006}.$$

We can combine these two relationships to write 2007 prices in terms of 2005 prices:

$$P_1^{2007} = 1.05(1.05P_1^{2005}) = 1.05^2P_1^{2005} \quad and \quad P_1^{2007} = 1.05(1.05P_1^{2005}) = 1.05^2P_1^{2005}.$$

And therefore nominal GDP in 2007 will be

$$\begin{aligned} NGDP &= 1.05^2 P_1^{2005} \times Q_1^{2007} + 1.05^2 P_2^{2005} \times Q_2^{2007} \\ &= 1.05^2 (P_1^{2005} \times Q_1^{2007} + P_2^{2005} \times Q_2^{2007}) \\ &= 1.05^2 RGDP. \end{aligned}$$

So we can now calculate the 2007 GDP deflator:

$$\begin{aligned} GDP\ Deflator &= \frac{1.05^2 RGDP}{RGDP} \times 100 \\ &= 1.05^2 \times 100 \\ &= 110.25. \end{aligned}$$

The lesson is that the percentage increase in the price level *compounds* over time—a consistent 5% increase in prices does not increase the GDP deflator by 5 every year.