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Principles of Microeconomics

Examples of Income and Substitution Effects

Case where Donuts are neither a Gross Complement nor a Gross Substitute for Coffee

I confess. I'm a Dunkin' Donuts Junkie. I spend all of my income on coffee and donuts. I earn $100 per week and I spend it all on coffee and donuts. Every week I buy 25 donuts and 25 coffees.

But something strange is about to happen in Donut World. The price of donuts has always been $2 and the price of coffee has always been $2, but when I wake up tomorrow, the price of donuts will fall to $1.

What a wonderful day! My money income won't change, but my real income (purchasing power) will be higher since I'll now be able to purchase more coffee and more donuts.

The relative price of donuts will also fall from $\frac{\$2/\text{donut}}{\$2/\text{coffee}} = 1\frac{\text{coffee}}{\text{donut}}$ to $\frac{\$1/\text{donut}}{\$2/\text{coffee}} = 0.5\frac{\text{coffee}}{\text{donut}}$ and that will suit me just fine as I sink my teeth into a delicious Boston Cream and savor the fact that I now have to give up less coffee to eat more of my favorite donuts.

All I have to do now is figure out how much coffee and donuts I'll consume after the price of donuts falls.

substitution effect

Had Dunkin' Donuts held my real income (purchasing power) constant, by changing the price of donuts to $1.33 and the price of coffee to $2.67, I could have continued to consume 25 donuts and 25 coffees, but because the relative price of donuts would have fallen to $\frac{\$1.33/\text{donut}}{\$2.67/\text{coffee}} = 0.5\frac{\text{coffee}}{\text{donut}}$, I would have been offered an opportunity to relish more fluffy donuts than before.

To take advantage of that opportunity however, I'd have to drink a few less coffees, but I would have gladly given up those coffees, because powering myself up on 18**.**75 coffees and 37**.**5 donuts gives me more utility (satisfaction) than 25 coffees and 25 donuts.

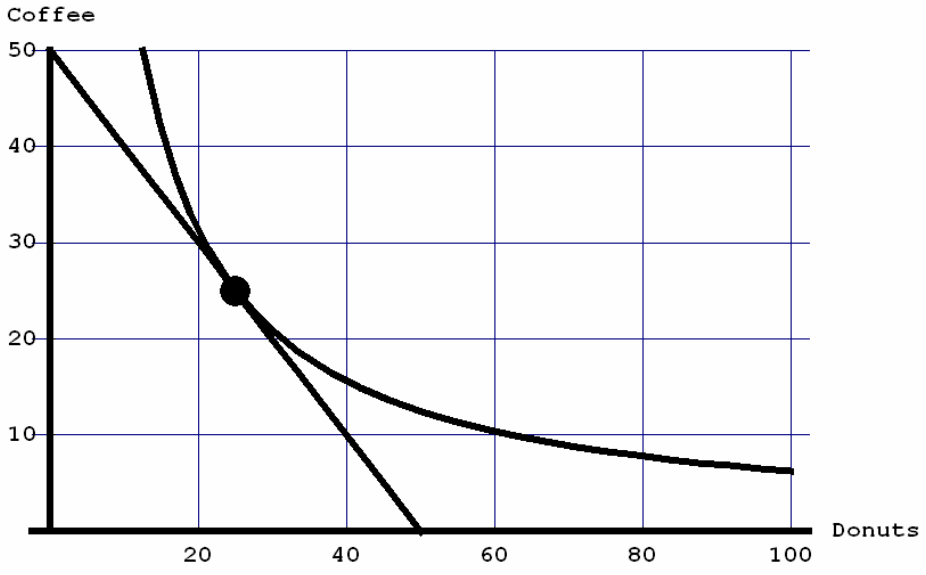
income effect

Fortunately, Dunkin' Donuts won't hold my real income constant, so I'll be able to consume more donuts and more coffees on my meager income.

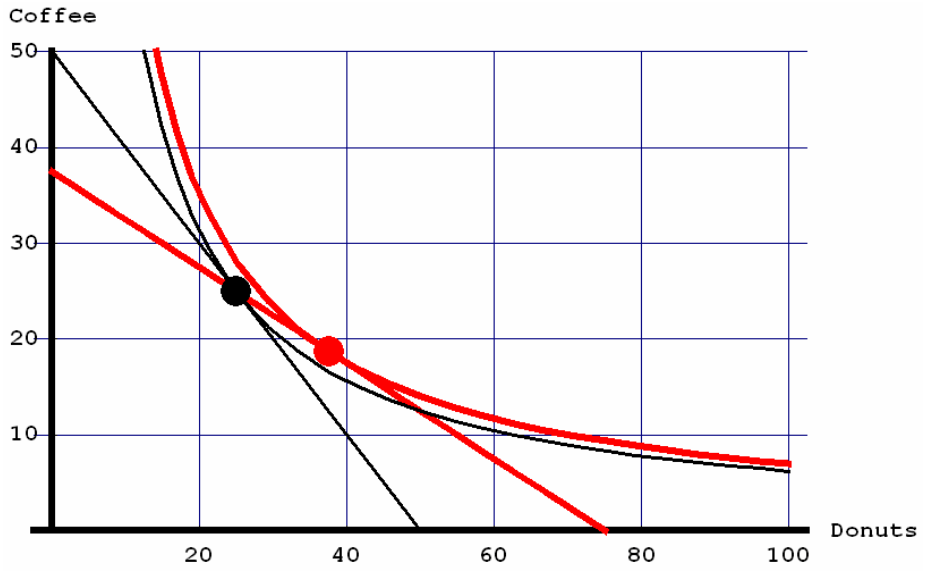
Nonetheless, it was helpful to examine the effect of a change in the relative price while holding my real income constant, because now I know that – if both income elasticities equal one – I'll always want to consume twice as many donuts as coffees at a relative price of $0.5\frac{\text{coffee}}{\text{donut}}$. Since the new price of donuts will be $1 and the price of coffee will remain $2, I'll consume 50 donuts and 25 coffees after the price change.

Therefore, by the income effect, I'll increase my consumption of coffee from its substitution effect level of 18**.**75 to 25 and I'll increase my consumption of donuts from its substitution effect level of 37**.**5 to 50.

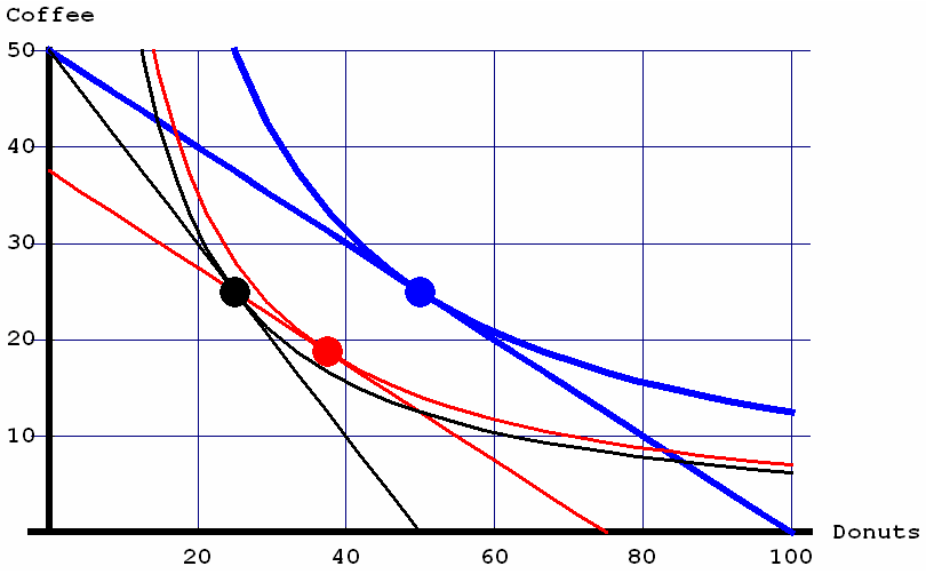
Initial Budget Constraint and Indifference Curve



Initial and **Substitution Effect**

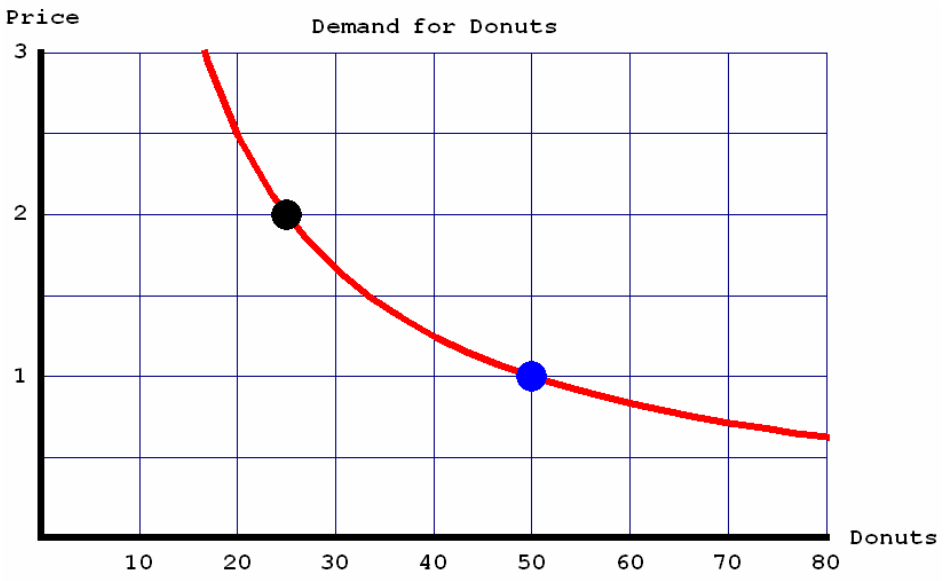


Initial, Substitution Effect and **Income Effect**



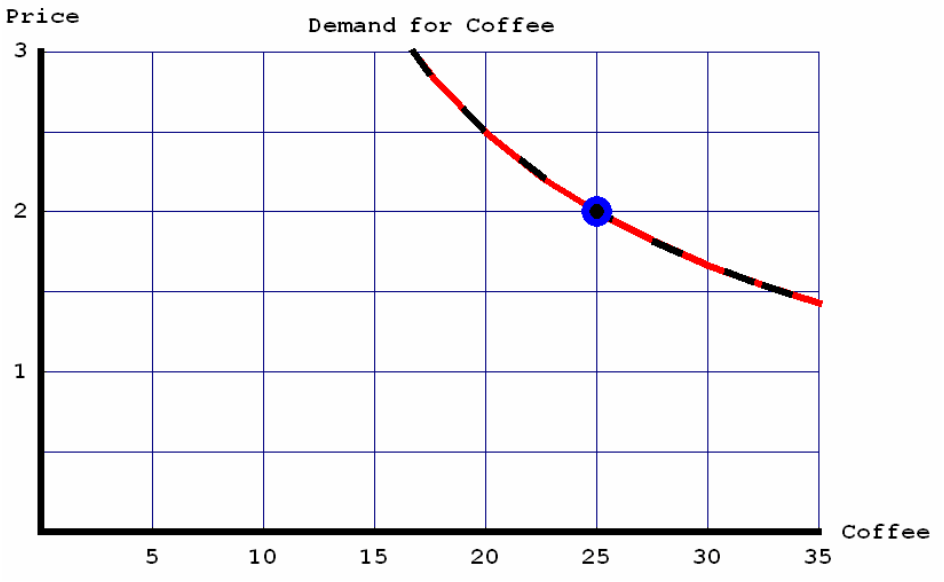
Demand Curves in the Case where Donuts are neither a Gross Complement nor a Gross Substitute for Coffee

Notice how a decrease in the price of donuts, increases the quantity of donuts that I demand. Specifically, when the price is $2, I demand 25 donuts, but when the price is $1, I demand 50. By connecting those two points on a graph we can sketch out the demand curve.



The price elasticity of demand for donuts is constant (all along this demand curve) and equal to negative one.

Since donuts are neither a gross complement nor a gross substitute for coffee, the demand curve for coffee doesn't shift at all. It remains right where it was before the price of donuts fell. Therefore, the elasticity of demand for coffee with respect to the price of donuts equals zero.



Is this realistic? Maybe. But it seems more plausible to me that I would use some of my increased purchasing power to buy more coffee. In such a case, donuts would be a gross complement to coffee and we'd have to modify our analysis – as I'll do on the next three pages.

Case where Donuts are a Gross Complement to Coffee

I'm still a Dunkin' Donuts Junkie. I still spend all of my income on coffee and donuts. I still earn $100 per week. I still spend it all on coffee and donuts and I still buy 25 donuts and 25 coffees every week.

Once again, let's assume that the price of donuts has always been $2 and the price of coffee has always been $2. Once again, let's assume that when I wake up tomorrow, the price of donuts will fall to $1.

Once again, my money income won't change, but my real income (purchasing power) will be higher since I'll now be able to purchase more coffee and more donuts.

As before, the relative price of donuts will also fall from $\frac{\$2/\text{donut}}{\$2/\text{coffee}} = 1\frac{\text{coffee}}{\text{donut}}$ to $\frac{\$1/\text{donut}}{\$2/\text{coffee}} = 0.5\frac{\text{coffee}}{\text{donut}}$ so once again I'll now have to give up less coffee to eat more of my favorite donuts.

The difference this time is that I'm going to increase my consumption of both coffee and donuts after the price of donuts falls.

substitution effect

Just like the previous case, had Dunkin' Donuts held my real income constant, by changing the price of donuts to $1.33 and the price of coffee to $2.67, I could have continued to consume 25 donuts and 25 coffees, but because the relative price of donuts would have fallen to $\frac{\$1.33/\text{donut}}{\$2.67/\text{coffee}} = 0.5\frac{\text{coffee}}{\text{donut}}$ I would once again have been offered an opportunity to eat more donuts.

To take advantage of that opportunity, I'd have to drink a few less coffees, but I would have gladly given up those coffees, because powering myself up on 20**.**37 coffees and 34**.**26 donuts gives me more utility (satisfaction) than 25 coffees and 25 donuts.

Note that in this case **my indifference curves are more L-shaped** (than they were in the previous case), so my substitution effect consumption levels are 20**.**37 coffees and 34**.**26 donuts (as compared with 18**.**75 coffees and 37**.**5 donuts in the previous case).

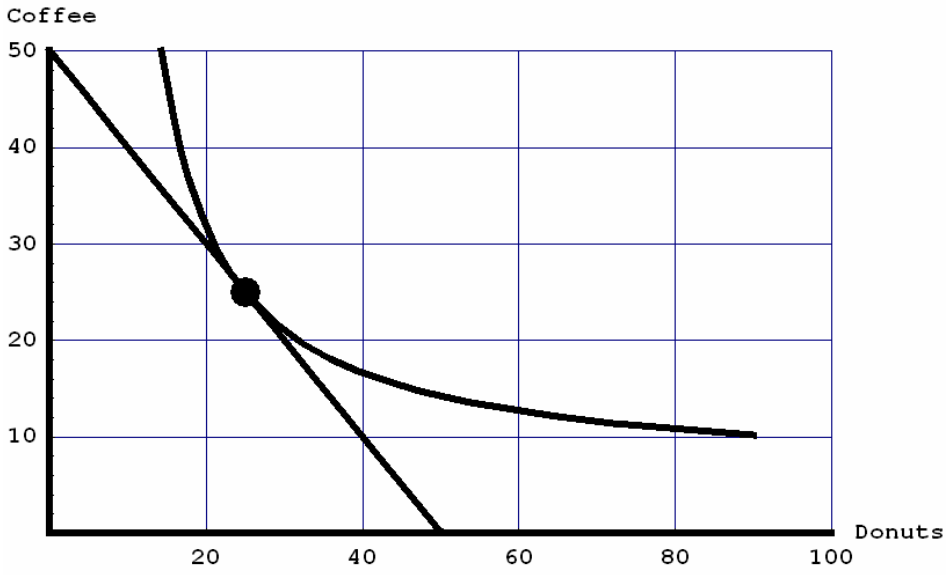
income effect

Once again, Dunkin' Donuts won't hold my real income constant and I'll be able to consume more donuts and more coffees on my meager income.

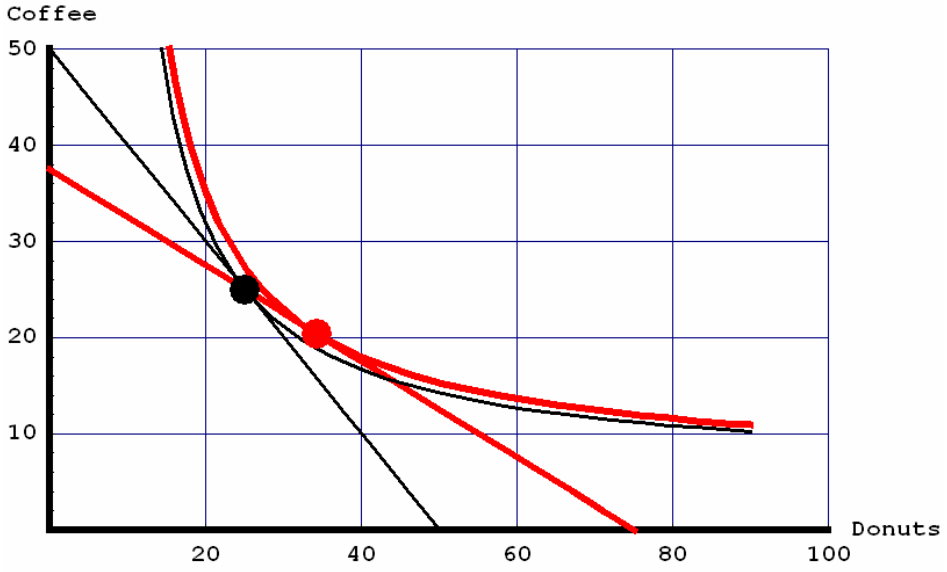
Nonetheless, it was helpful to examine the effect of a change in the relative price while holding my real income constant, because now I know that – if both income elasticities equal one – I'll always want to consume 1**.**68 donuts per coffee at a relative price of $0.5\frac{\text{coffee}}{\text{donut}}$. Since the new price of donuts will be $1 and the price of coffee will remain $2, I'll consume 45**.**68 donuts and 27**.**16 coffees after the price change.

By the income effect, I'll increase my consumption of coffee from its substitution effect level of 20**.**37 to 27**.**16 and I'll increase my consumption of donuts from its substitution effect level of 34**.**26 to 45**.**68.

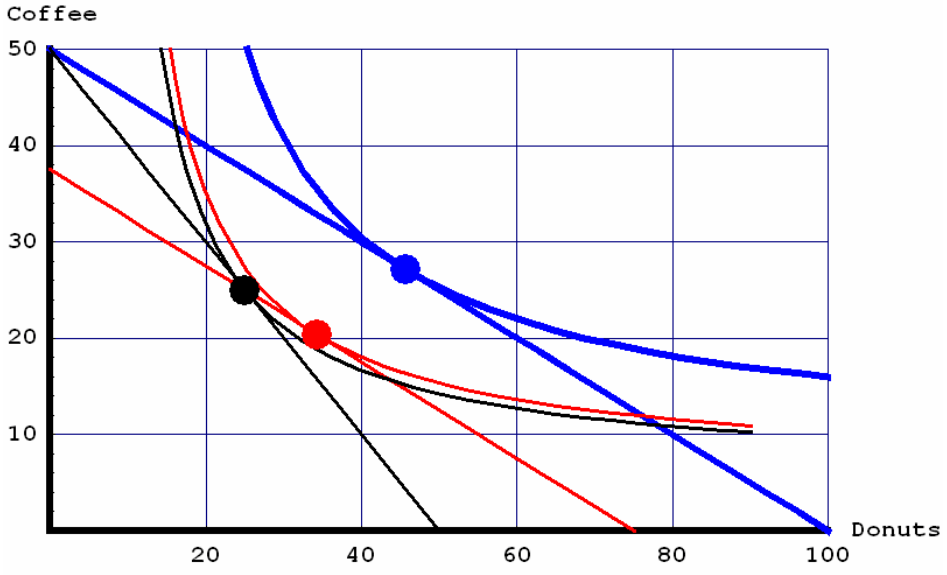
Initial Budget Constraint and Indifference Curve



Initial and **Substitution Effect**

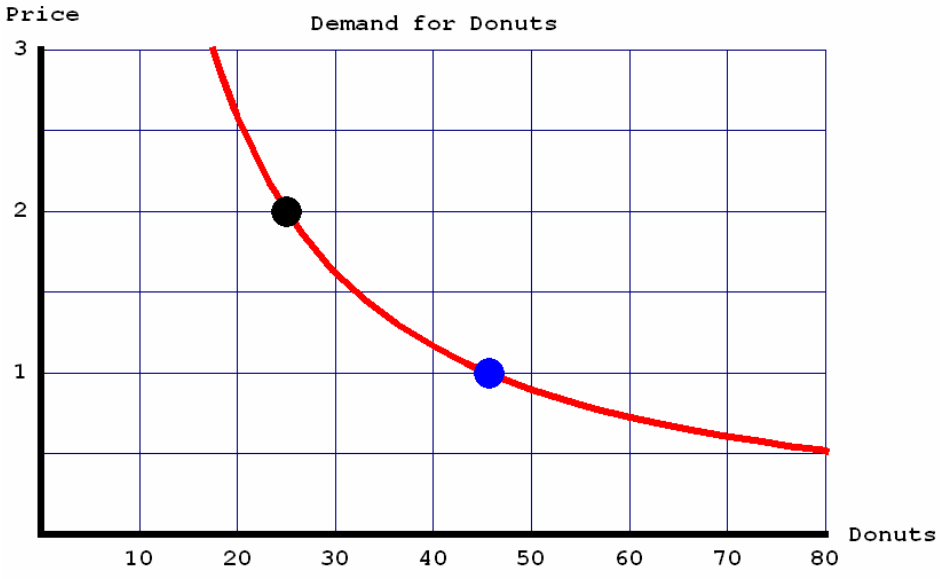


Initial, Substitution Effect and **Income Effect**



Demand Curves in the Case where Donuts are a Gross Complement to Coffee

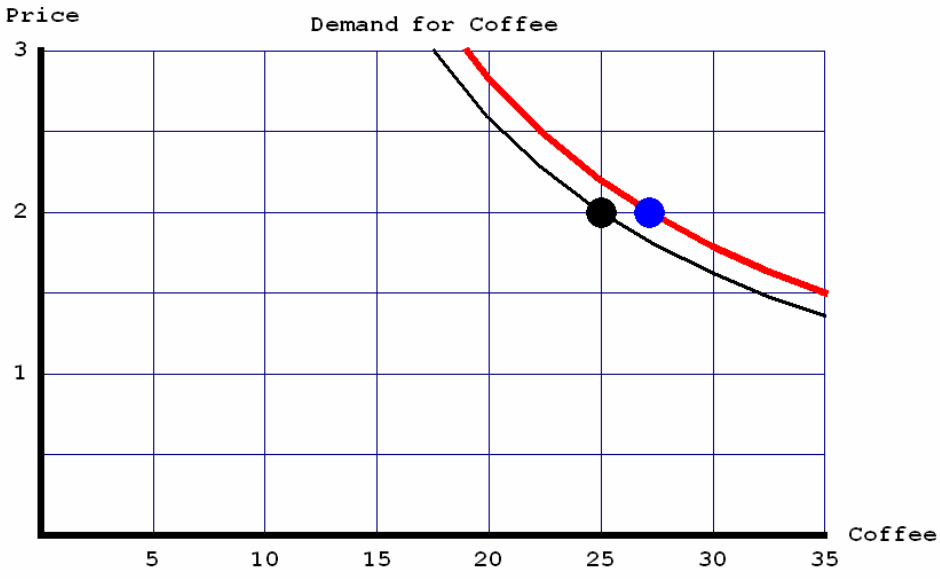
Once again, a decrease in the price of donuts, increases the quantity of donuts that I demand. Specifically, when the price is $2, I demand 25 donuts, but when the price is $1, I demand 45.68. Once again, we can sketch out the demand curve by connecting those two points on a graph.



Does that demand curve look less elastic to you than the one in the case where donuts are neither a gross complement nor a gross substitute for coffee? It should. The price elasticity of demand for donuts at a price of $2 per donut is –0.875 and at a price of $1 per donut it's –0.864.

Since donuts are a gross complement to coffee, my consumption of coffee rises from 25 to 27.16 when the price of donuts falls from $2 to $1. Graphically, the demand curve for coffee shifts outward when the price of donuts falls (because I'm demanding more coffee at a price of $2).

The elasticity of demand for coffee with respect to the price of donuts equals –0.125 at a price of $2 per donut and it equals –0.115 at a price of $1 per donut.



Case where Wine is a Gross Substitute for Beer

I'll use beer and wine to illustrate gross substitutes, but the analysis will be identical to the previous cases.

This time I'm an alcoholic. I still earn $100 per week, but this time I spend it all on beer and wine and I buy 25 bottles of wine and 25 bottles of beer every week.

To preserve the similarity, let's assume that the price of beer has always been $2 and the price of wine has always been $2. Once again, let's assume that tomorrow the price of wine will fall to $1.

Once again, my money income won't change, but my real income (purchasing power) will be higher since I'll now be able to purchase more wine and more beer.

Similarly, the relative price of wine will fall from $\frac{\$2/\text{wine}}{\$2/\text{beer}} = 1\frac{\text{beer}}{\text{wine}}$ to $\frac{\$1/\text{wine}}{\$2/\text{beer}} = 0.5\frac{\text{beer}}{\text{wine}}$ so once again, I'll now have to give up less beer to drink more of my favorite wine.

Compared with the previous cases, the difference this time is that I'm going to increase my consumption of wine and reduce my consumption of beer after the price of wine falls.

substitution effect

Just like the previous cases, had the liquor store held my real income constant, by changing the price of wine to $1.33 and the price of beer to $2.67, I could have continued to consume 25 wines and 25 beers, but because the relative price of wine would have fallen to $\frac{\$1.33/\text{wine}}{\$2.67/\text{beer}} = 0.5\frac{\text{beer}}{\text{wine}}$ I would once again have been offered an opportunity to drink more wine.

To take advantage of that opportunity, I'd have to drink a few less beers, but I would have gladly given up those beers, because inebriating myself up on 12**.**5 beers and 50 wines gives me more utility (satisfaction) than 25 beers and 25 wines.

Note that in this case **my indifference curves are flatter** (than they were in the previous cases), so my substitution effect consumption levels are 12**.**5 beers and 50 wines (as compared with 20**.**37 coffees and 34**.**26 donuts in the previous case where donuts are a gross complement to coffee).

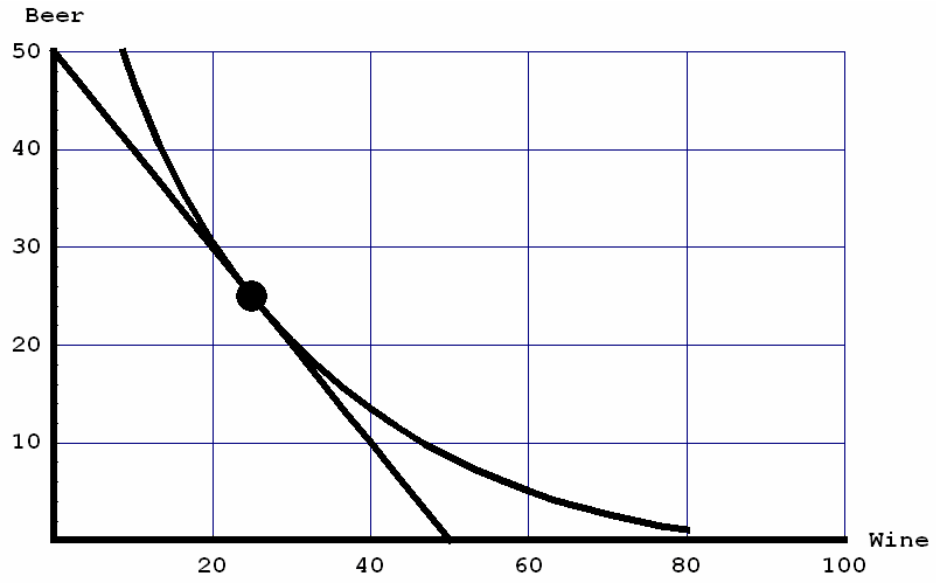
income effect

Once again, the liquor store won't hold my real income constant and I'll be able to consume more wines and more beers on my meager income.

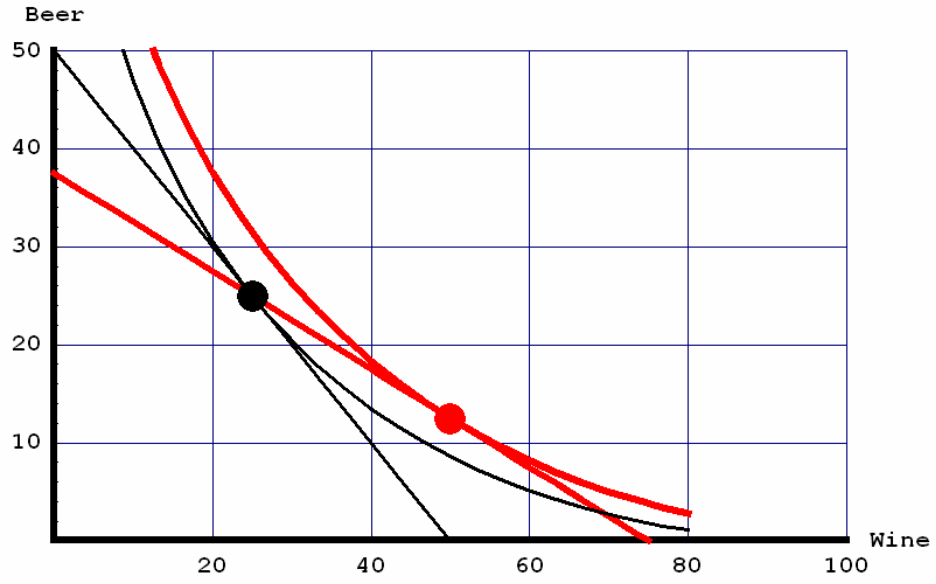
Nonetheless, it was helpful to examine the effect of a change in the relative price while holding my real income constant, because now I know that – if both income elasticities equal one – I'll always want to consume four wines per beer at a relative price of $0.5\frac{\text{beer}}{\text{wine}}$. Since the new price of wine will be $1 and the price of beer will remain $2, I'll consume 66**.**67 wines and 16**.**67 beers after the price change.

By the income effect, I'll increase my consumption of beer from its substitution effect level of 12**.**5 to 16**.**67 and I'll increase my consumption of donuts from its substitution effect level of 50 to 66**.**67.

Initial Budget Constraint and Indifference Curve



Initial and **Substitution Effect**



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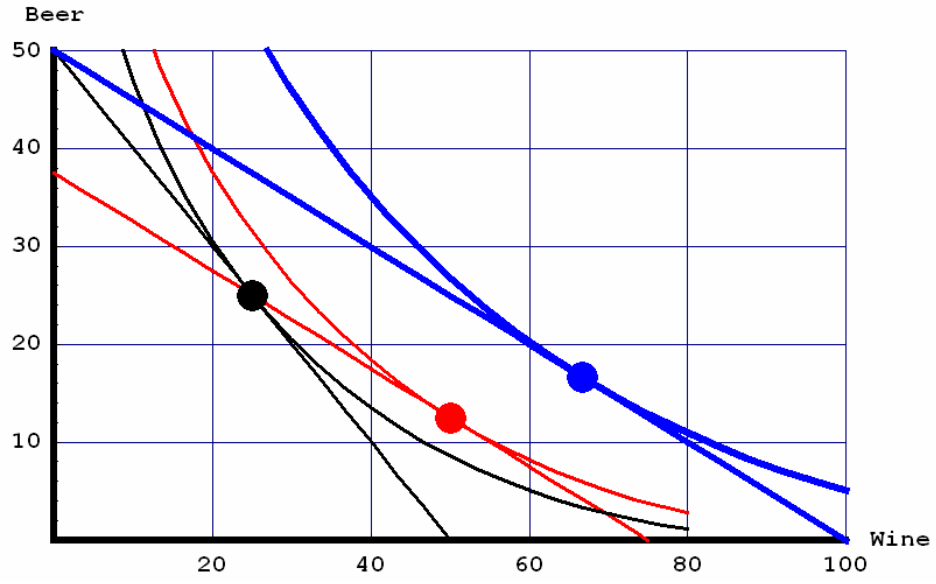
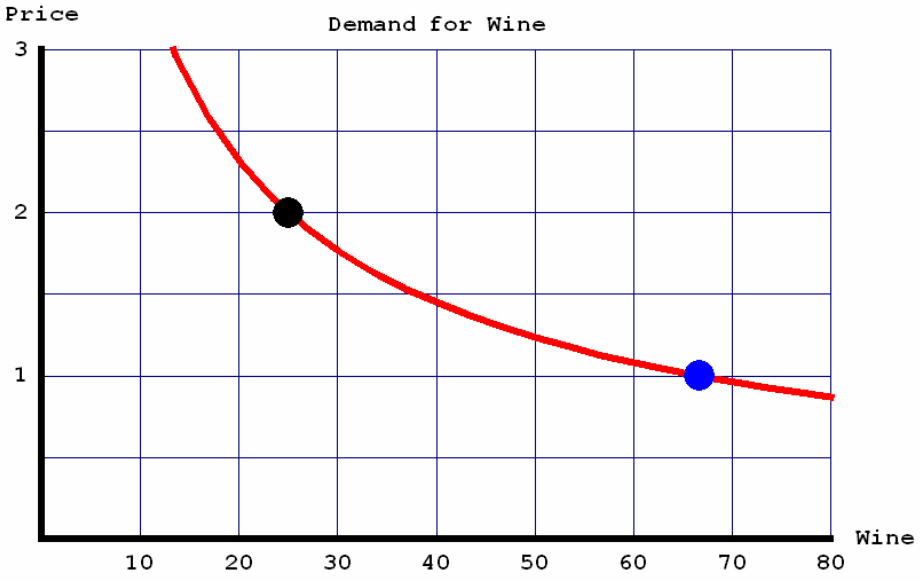


Demand Curves in the Case where Wine is a Gross Substitute for Beer

Once again, a decrease in the price of wine, increases the quantity of wine that I demand. Specifically, when the price is $2, I demand 25 wines, but when the price is $1, I demand 66.67. Once again, we can sketch out the demand curve by connecting those two points on a graph.



Does that demand curve look more elastic to you than the ones in the previous cases? It should. The price elasticity of demand at a price of $2 is –1.5 and at a price of $1 it's –1.33.

Since wine is a gross substitute for beer, my consumption of beer falls from 25 to 16.67 when the price of wine falls from $2 to $1. Graphically, the demand curve for beer shifts inward when the price of wine falls (because I'm demanding less beer at a price of $2).

The elasticity of demand for beer with respect to the price of wine equals 0.5 at a price of $2 per wine and it equals 0.667 at a price of $1 per wine. NB: In this case, the demand curve shift is larger (in absolute value) than the shift in the previous case. The difference in shift size is reflected in the larger cross price elasticities.