Quantitative Tools - level I **October 1, 2016**
Time Limit: 60 Minutes

First Midterm - Spring 2016

Instructions

- The use of a mobile phone, or any other means of communication, is forbidden.
- Give all the results with a two decimals precision.
- Write answers on a separate sheet of paper.

Zamalek, Cairo 2011

1 Malek's Boutique (9 points)

Malek, a greengrocer, owns a small boutique in Zamalek, Cairo. The prices including taxes are the following :

Vegetables	Prices
Potatoes	2 EGP/kg
Eggplant	1 EGP/kg
Mango	4 EGP/kg

Malek is selling 10kg of potatoes a day, 10% more Eggplant and 20% less Mango than potatoes. The VAT is 15% and Malek makes a 20% markup (defines as the ratio of profit and price without tax) on its sales.

1. For each kilogram of sold mango, how much goes to Malek ?
2. Compute Malek's daily earnings

VAT increases from 15% to 16%. How does Malek earnings change if

3. he does not change the price with tax
4. he does not change the price without tax

Malek choose the second option and we now assume that the VAT rate is 16%.

5. Assuming that there are thirty days a month, what are Malek yearly earnings ?
6. The poverty line stands at 5,000 EGP in Egypt. By how much should Malek increase its daily earnings (in %) so that he reaches the poverty line ?
7. Malek increases its earnings by 10% each year. In how many years will he reach the poverty line ?

Inflation was 15% last year whereas Malek earnings only grown up by 10%.

8. How has Malek's purchasing power changed last year ?
9. Assuming inflation remains constant this year (at 15%), by how much should Malek increase its earnings so that average inflation over the two years equals the average growth rate of Malek's earnings ?

2 The last shall stay last (5 points)

The evolution of prices in Egypt between 2010 and 2013 had been the following :

	Potatoes	Eggplant	Mango	Lamb
2011	+5%	+10%	-1%	-2%
2012	+2%	+3%	2%	1%
2013	+1%	+4%	3%	3%

Consumption expenditure of households in Egypt split according to the following table

	Representative Household	Top Tier	Bottom Tier
Potatoes	30 %	20%	45%
Eggplant	30 %	20%	45%
Mango	30 %	20%	10%
Lamb	10 %	40%	0%

1. Compute the Paasche index for the representative household
2. Compute the Laspeyres index (using 2010 as the baseline period) for the representative household, top tier households, bottom tier households
3. Compute inflation rate using the Laspeyres index for the three different types of household. What can you say on the evolution of purchasing power amid the different types of households ?

3 EGP black market (3 points)

One Egyptian Pound (EGP) worths 0.13 $US in financial markets (this is the nominal rate). Ikea sells a Billy bookcase at 645EGP in Egypt and at 69.99$ in US. We will use Billy Bookcase prices for a proxy of price levels in both US and Egypt.

1. What do you think of the EGP, is it overvalued or undervalued ?
2. How should the nominal exchange rate adjust (in %) so that the real exchange rate equals 1 ?
3. Malek is importing potatoes from Sudan and pays them in USD. If the EGP is devaluated by 10%, how would that impact Malek earnings ? (Hint : use the markup rate and the VAT rate to compute the costs of 1kg of potatoes in USD)

4 Malek empire (3 points)

A few years later, Malek has expanded his business. His income has surged to 15'000 EGP a year. The income tax is progressive according to the following table :

Income ranges		
0 - 5000	5000 - 10000	Above 10,000
0%	5%	15 %

Table 1: Income tax rates

1. What is the amount of taxes paid by Malek ?
2. For each new EGP earned by Malek, how much goes to Malek's pocket ?

Malek has hired a dozen of employees and pays them according to the following table :

Wages	Frequencies
1000 - 2000	3
2000 - 3000	7
3000 - 4000	5
4000 - 5000	2

Table 2: Distribution of the wages in Malek's firm

3. What is the modal class ?
4. What is the median class ?

5 Bonus questions - Malek leavened bread (+2 points)

Malek has decided to expand further his business and to open bakeries slack in his boutiques. In order to produce leavened bread, he is making a culture of lactic acid bacteria. Each day, the same proportion of bacteria is reproducing itself. When a bacterium is reproducing itself, it gives birth to a new bacterium which can also reproduce itself the next day. So if there is 4 bacteria and half of it reproduce itself, the next days there are $4+4/2 = 6$ bacteria. And the day after $6+6/2 = 9$ bacteria. We suppose that this proportion is constant in time and that half of a bacterium gives birth to an other half (so we have no problem with non-integers).
At the beginning of the experiment, Malek grows 100 bacteria in culture. At the end of the experiments, 30 days after, Malek lab has 175 bacteria.

1. Each day, what is the proportion of bacteria that reproduces itself ?
2. 15 days after the beginning of the experiment, how many bacteria does the lab have ?

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