Profit maximization in different market structures

In the cappuccino problem as well in your team project, demand is clearly downward sloping – if the store wants to sell more drink, it has to lower the price.

In the problems we did last time, the price the firm could get for each unit of output did not depend on the number of units produced.

Which way is right?

Which way is more realistic therefore more relevant?
Traditionally, economics textbooks distinguish four types of markets, or of market structures.

They differ in the degree of *market power* an individual firm has:

- **Perfect competition**  
  *the least market power*
- **Monopolistic competition**
- **Oligopoly**
- **Monopoly**  
  *the most market power*

“*Market power*” also known as “*pricing power*” is defined in the managerial literature as *the ability of an individual firm to vary its price while still remaining profitable* or as *the firm’s ability to charge the price above its MC*. 
Perfect competition

The features of a perfectly competitive market are:

• Large number of competing firms;
• Firms are small relative to the entire market;
• Products different firms make are identical;
• Information on prices is readily available.
As a result, the price is set by the interaction of supply and demand forces, and an individual firm can do nothing about the price.

This is the story of any small-size firm that cannot differentiate itself from the others.

(Individual firm’s demand is perfectly elastic).
What does a **Total Revenue (TR)** graph look like for such a firm, if plotted against quantity produced/sold?

Every unit sells at the same price so…

Slope equals price
How about the Marginal Revenue graph?

Every unit sells at the same price so...

MR = P
The profit maximization story told graphically:

In aggregate terms:
In marginal terms:

\[ MC \]

\[ MR \]

max profit
Doing the same thing mathematically:

$\text{TC} = 100 + 40 \ Q + 5 \ Q^2$, 

And the market price is $160,

What is the profit maximizing quantity (remember, price is determined by the market therefore it is given)?

Just like in the case with tabular data, there are two approaches.
1. Aggregate:

Profit = TR – TC = 160 Q – (100 + 40 Q + 5 Q²) =

= 120 Q – 100 – 5 Q²

A function is maximized when its derivative is zero; Specifically, when it changes its sign from ( + ) to ( – )

d(Profit)/dQ = 0

120 – 10 Q = 0

Q = 12
2. Marginal (looking for the $\text{MR} = \text{MC}$ point)

$\text{MR} = \text{Price} = $160

$\text{MC} = \frac{d(\text{TC})}{dQ}$

$\text{TC} = 100 + 40Q + 5Q^2$

$\text{MC} = 40 + 10Q$

$\text{MR} = \text{MC}$

$160 = 40 + 10Q$

$120 = 10Q$

$Q = 12$
What if the market is **NOT perfectly competitive**?

(This happens if some or all of the attributes of perfect competition are not present. For example:

- The firm in question is large (takes up a large portion of the market);

- The firm produces a good that consumers perceive as different from the others;

- Searching for the best deal is costly for consumers;

  Etc.)
For now, we will consider

Monopolistic competition and Monopoly

Many small firms - One LARGE firm

Fairly easy entry and exit - Entry is very costly or impossible

In both markets, a firm can vary its price to some extent

As a firm in either of these markets raises its price, the quantity it is able to sell drops –

Demand curve is downward sloping!
Demand curve of an individual firm:
Total Revenue:

TR is not directly proportional to the quantity produced because in this case in order to sell more, the firm needs to lower its price.
Recall that Marginal Revenue, MR tells us what happens to the total revenue as the quantity produced increases by one unit.

$\text{MR} > 0$ tells us that increasing Q would increase TR.

If $\text{MR} < 0$, then increasing Q would decrease TR.
We can also trace what happens to revenue and elasticity as we move along the demand curve (reusing an exercise from two weeks ago).

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<th>Q</th>
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In fact, MR represents the slope of the TR curve plotted against output, Q.

Thus when MR changes its sign from ( + ) to ( – ) as we move along the quantity axis, ...

Total revenue is maximized
Marginal Revenue as a function of quantity:

- Starts out positive;
- Gradually decreases;
- Hits zero when TR = MAX;
- Goes on into the negative range.
In fact, when demand is linear, so is MR

MR and demand curves share the same vertical intercept but MR decreases twice as fast.
The profit maximization story told graphically:
In aggregate terms:
In marginal terms:

Note that for a profit-maxing firm with market power, the price is always higher than the $MC$ of the last item produced.

The more market power a firm has, the greater that difference ("profit margin", "markup").
Recall also that *profit* is maximized where $MR = MC$…

…whereas *revenue* is maximized where $MR = 0$.

For an imperfectly competitive firm, profit is always maximized at a smaller output quantity (therefore at a higher price) than revenue is maximized.
Analytically:
\[ TC = 100 + 40 \, Q + 5 \, Q^2 \]

And the demand facing the firm is given by
\[ Q_D = 25 - 0.1 \, P \]

What is the profit maximizing quantity AND price?

(\textit{was done in class})
Bad news:
Using the above analytical approach (in either version) is possible only if you have **full information** about your MC and demand schedules.

Good news:
Even **in the absence of complete information**, you can use a simple rule to get a ball park estimate for your optimal price, or at least an idea of what needs to be done to increase your profit.
It can be shown mathematically that

\[ MR = P \left( 1 + \frac{1}{E} \right) = P \left( \frac{1 + E}{E} \right) \]

where \( E \) is the own price elasticity of demand (preserving the negative sign).

(This is just a mathematical property that always holds.)
Now we know a firm wants to be where \( MR = MC \), therefore

\[
MC = P \left( \frac{1+E}{E} \right)
\]

or

\[
MC \cdot E = P(1+E)
\]

or

\[
P = MC \left( \frac{E}{1+E} \right)
\]
If you have an idea about your marginal costs (which you usually do) and your own price elasticity (which is not that hard to obtain), then you may get an idea whether you are maximizing profits and what changes need to be made if you are not.