1 Question #1

The production of Honey usually generates a side effect or positive externality. That is, the pollination of surrounding crops by bees. In some cases, the value generated by the pollination may be more important than the value of the harvested honey. In order to promote this activity, the government sets a subsidy for the honey industry. Assume that the market demand (or marginal private benefit, \( MB_P \)), the marginal external benefit, \( MB_E \), and marginal cost, \( MC \), are:

\[
\begin{align*}
\text{Demand}(MB_P) & : \quad P = 10 - q \\
MB_E & = 5 - \frac{1}{2}q \\
MC & = q
\end{align*}
\]

a. Determine the government cost from the subsidy and Consumer and Producer surplus (before and after the subsidy)

2 Solution

Let us first identify the market equilibrium in which \( MB_P = MC \) or,

\[
10 - q = q \\
q^M = 5
\]

Substituting \( q^M \) into the demand function we obtain the equilibrium price \( p^M = 10 - 5 = 5 \).

In order to calculate the socially optimal output level we, first, need to identify the marginal social benefit function which is

\[
MB_S = MB_P + MB_E = [10 - q] + \left[ 5 - \frac{1}{2}q \right]
\]

\[
MB_S = 15 - 1.5q
\]

In addition, we know that the socially optimal output level can be obtained using \( MB_S = MC \) or,

\[
15 - 1.5q = q \\
q^* = \frac{15}{2.5} = 6
\]

and the optimal price is

\[
p(MB_S) = 15 - 1.5 \times 6 \\
p^S = 6
\]

However, consumers are willing to pay a different price. Let us identify such a price using the demand function (or \( MB_P \))

\[
p^* = 10 - 6 = 4
\]

Hence, the difference between \( p^S \) and \( p^* \) represents the subsidy which is

\[
\text{Subsidy} = p^S - p^* = 6 - 4 = 2
\]
Our results can be summarized using the following graph

We next calculate (1) the Government Cost, (2) Consumer Surplus and (3) Producer Surplus before and after the subsidy.

2.1 Government Cost
The Government Cost before the subsidy is zero; however, after the subsidy it is represented by the area of the rectangle ABCD. Hence, the cost is \( GC = 2 \times 6 = 12 \)

2.2 Consumer Surplus (CS)
The CS before the subsidy is represented by the area FGH, hence,
\[
CS(\text{Before Subsidy}) = \frac{(10 - 5) \times 5}{2} = 12.5
\]
The CS after the subsidy is represented by the area FCD, hence,
\[
CS(\text{After Subsidy}) = \frac{(10 - 4) \times 6}{2} = 18
\]

2.3 Producer Surplus (PS)
The PS before the subsidy is represented by the area GHJ, hence,
\[
PS(\text{Before Subsidy}) = \frac{(5 - 0) \times 5}{2} = 12.5
\]
The PS after the subsidy is depicted by the area ABJ, therefore,
\[
PS(\text{After Subsidy}) = \frac{(6 - 0) \times 6}{2} = 18
\]

Finally, we need to measure the total external benefit of producing \( q^* = 6 \). Using the area GKL and LKMJ we obtain that
\[
TBE = \left( \frac{(5 - 2) \times 6}{2} \right) + [2 \times 6] = 21
\]

Hence, our results suggest that the increase in consumer and producer surplus (5.5 each) does not compensate the cost of this policy \( GC \) since 11 < 12. However, if we consider the increase in the total external benefit, then the government cost is compensated.