Econ HW 2

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1. Aggregate Demand, Supply, and Surplus

```
# Find demand curves using linear regression:

demand_high <- lm(data = demand, price ~ qhigh)
demand_low <- lm(data = demand, price ~ qlow)

int_h <- demand_high$coefficients[1]
q_high <- abs(demand_high$coefficients[2])

int_l <- demand_low$coefficients[1]
q_low <- abs(demand_low$coefficients[2])
```

High income demand curve:
$Price = (23.3914418) - (1.2966378 \times 10^{-4})Q$

Low income demand curve:
$Price = (21.9908534) - (1.3551741 \times 10^{-4})Q$

a. Find Aggregate Demand

```
# Writing functions for demand:

d_high <- function(q) {
  int_h - (q_high*q)
}

d_low <- function(q) {
  int_l - (q_low*q)
}

# Demand as a function of quantity add together for aggregate demand:

d_highq <- function(p){
  (int_h/q_high) - (p/q_high)
}

d_lowq <- function(p) {
  (int_l/q_low) - (p/q_low)
}


# Find the slope and intercept for the aggregate demand:
agg_int <- (int_h/q_high) + (int_l/q_low)
agg_slope <- abs((-1/q_high) + (-1/q_low))

# Write aggregate demand function as function of price:
```

```r
d_aggq <- function(p) {
  agg_int - agg_slope*p
}

# Change to a function of quantity:
d_agg <- function(q) {
  (agg_int/agg_slope) - ((1/agg_slope)*q)
}

# Quantity at equilibrium price of 5:
q_sq <- d_highq(5) + d_lowq(5)

# Find mpc by plugging in 5 for the AD curve:

mpc_slope <- (5/q_sq)

mpc <- function(q) {
  mpc_slope*q
}

mec <- function(y) {
  2
}
```

Aggregate demand curve:
$Price = (22.7066059) - (6.6262994 \times 10^{-5})Q$

b. Find the Supply Curve

Supply curve:
$Price = (1.8711376 \times 10^{-5}) * Q$

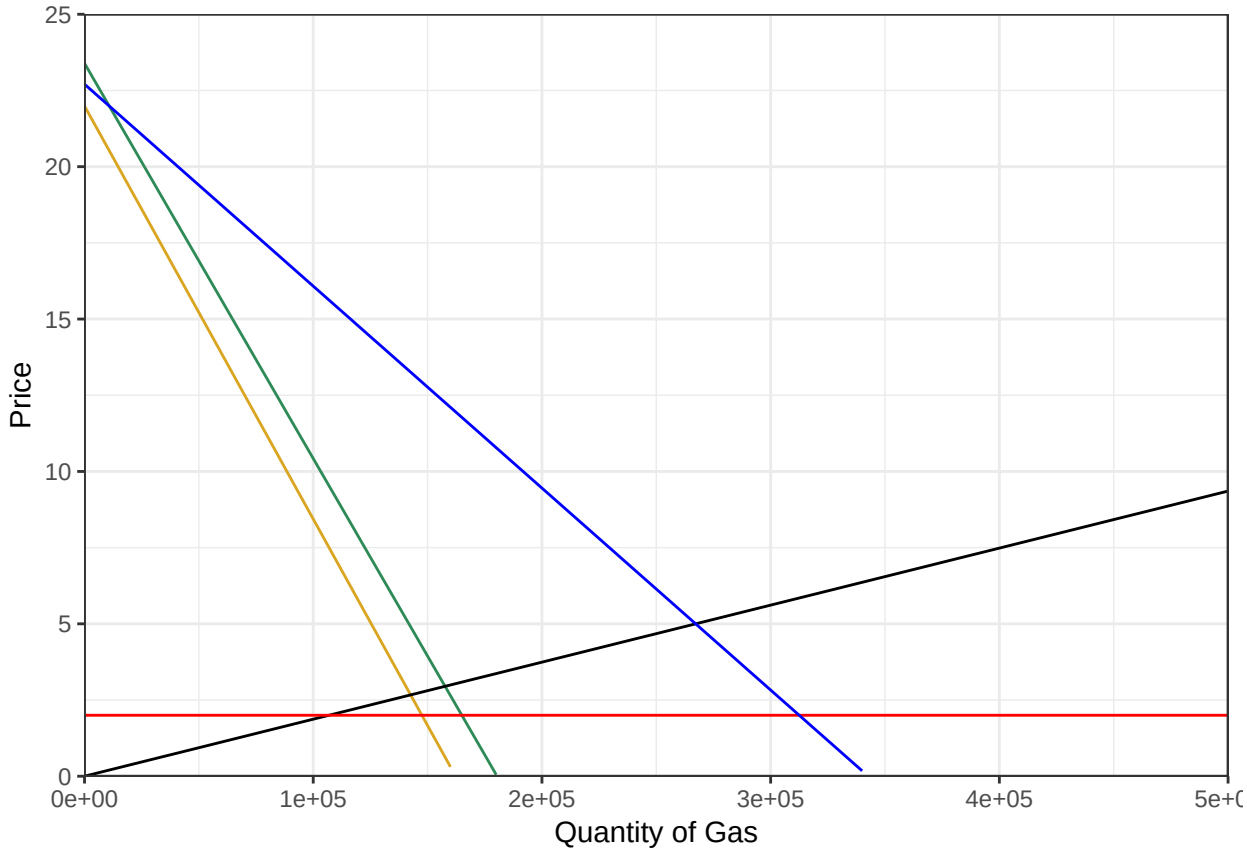
```r
#graphing the functions

ggplot(data.frame(x=c(70000:200000)), aes(x=x)) +
  stat_function(fun=d_high, geom ="line", color = "seagreen") +
  stat_function(fun=d_low, geom = "line", color = "goldenrod") +
  stat_function(fun=mpc, geom = "line") +
  stat_function(fun=mec, geom = "line", color = "red") +
  stat_function(fun=d_agg, geom = "line", color = "blue")+
  labs(x = "Quantity of Gas", y = "Price")+
  scale_x_continuous(limits =c(0,500000), expand = c(0,0))+
  scale_y_continuous(limits=c(0,25), expand=c(0,0))+
  theme_bw()
```

```
## Warning: Removed 64 rows containing missing values (geom_path).
```

```
## Warning: Removed 68 rows containing missing values (geom_path).
```

```
## Warning: Removed 32 rows containing missing values (geom_path).
```



c. Surplus under the Status Quo

```
######## Consumer Surplus using integration

# First find quantity where agg demand starts - quantity where price is equal to intercept of d_low
q_cshigh <- d_highq(int_l)

# Integrate to find area under curve for the high demand through quantity where agg starts
area_high <- integrate(d_high, lower = 0, upper = q_cshigh)

# Integrate agg demand from quantity it starts through the equilibrium quantity
area_agg <- integrate(d_agg, lower = q_cshigh, upper = q_sq)

# Find total cost at equilibrium (price*quantity)
cost <- 5*q_sq

# Add integrals and subtract cost
cs_total <- (area_high$value + area_agg$value) - cost


######### Producer Surplus using integration

# Integrate MPC find the area under curve through equilibrium quantity
mpc_area <- integrate(mpc, lower = 0, upper = q_sq)

# Find PS by subtracting area from cost
```

```
ps_total <- cost - mpc_area$value
```

Consumers:
$ConsumerSurplus = (2.3694528 \times 10^6)$

Producers:
$ProducerSurplus = (6.6804279 \times 10^5)$

d. Environmental Cost under the Status Quo

```
tec <- 2*q_sq
```

$EnvironmentalCost = (5.3443423 \times 10^5)$

2. Division of Consumer Benefit

```
# CS for high demand - area under curve from 0 to quantity at price 5 - (quantity*5)
q_high_sq <- d_highq(5)
fullarea_high <- integrate(d_high, lower = 0, upper = q_high_sq)
cost_high <- q_high_sq * 5
cs_high <- fullarea_high$value - cost_high

# CS for low demand - area under curve from 0 to quantity at price 5 - (quantity*5)
q_low_sq <- d_lowq(5)
fullarea_low <- integrate(d_low, lower = 0, upper = q_low_sq)
cost_low <- q_low_sq * 5
cs_low <- fullarea_low$value - cost_low
```

Consumer Surplus for High Income
$CS_(High) = (1.3043162 \times 10^6)$

Consumer Surplus for Low Income
$CS_(Low) = (1.0651366 \times 10^6)$

3. Implement a Gas Tax of $0.50/gallon

a. New quantity of gasoline

```
# Suppose the tax is placed on producers and the supply curve shifts left (new intercept 0.50)

# New equation for MPC with tax:

mpc_tax <- function(q) {
  0.50 + mpc_slope*q
}

# Find quantity where the MPC and aggregate demand intersect
q_tax <- ((agg_int/agg_slope)-0.50)/((1/agg_slope)+mpc_slope)
```

$Q_(Tax) = (2.6133299 \times 10^5)$

b. New price of gasoline

```r
# Price from aggregate demand with the new quantity

p_tax <- d_agg(q_tax)
```

$P_(Tax) = (5.3898999)$

c. Surplus to high income consumers

```r
# CS for high demand = area under curve from 0 to quantity at new price - (new quantity*new price)
q_high_tax <- d_highq(p_tax)
area_high_tax <- integrate(d_high, lower = 0, upper = q_high_tax)
cost_high_tax <- q_high_tax * p_tax
cs_high_tax <- area_high_tax$value - cost_high_tax
```

$CS_(High) = (1.2495992 \times 10^6)$

d. Surplus to low income consumers

```r
# CS for low demand = area under curve from 0 to quantity at new price - (new quantity*new price)
q_low_tax <- d_lowq(p_tax)
area_low_tax <- integrate(d_low, lower = 0, upper = q_low_tax)
cost_low_tax <- q_low_tax * p_tax
cs_low_tax <- area_low_tax$value - cost_low_tax
```

$CS_(Low) = (1.0168127 \times 10^6)$

e. Producer surplus

```r
# PS = (new quantity*new price) - area under curve through new quantity
mpc_area_tax <- integrate(mpc_tax, lower = 0, upper = q_tax)
cost_tax <- q_tax * p_tax
ps_tax <- cost_tax - mpc_area_tax$value
```

$PS_(Tax) = (6.3894607 \times 10^5)$

f. Environmental damage

```r
tec_tax <- 2*q_tax
```

$TEC\ Tax\ = (5.2266597 \times 10^5)$

g. Tax revenue

```r
# Revenue from taxes = (quantity with tax) * (price with the tax - the price of MPC with the tax quanti

# Find the price of MPC using the quantity with tax
p_mpc_tax <- mpc(q_tax)


# Calculate Revenue:
tax_rev <- q_tax * (p_tax - p_mpc_tax)
```

$TaxRevenue = (1.3066649 \times 10^5)$