

# 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:
```

```

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:**

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

*#graphing the functions*

```

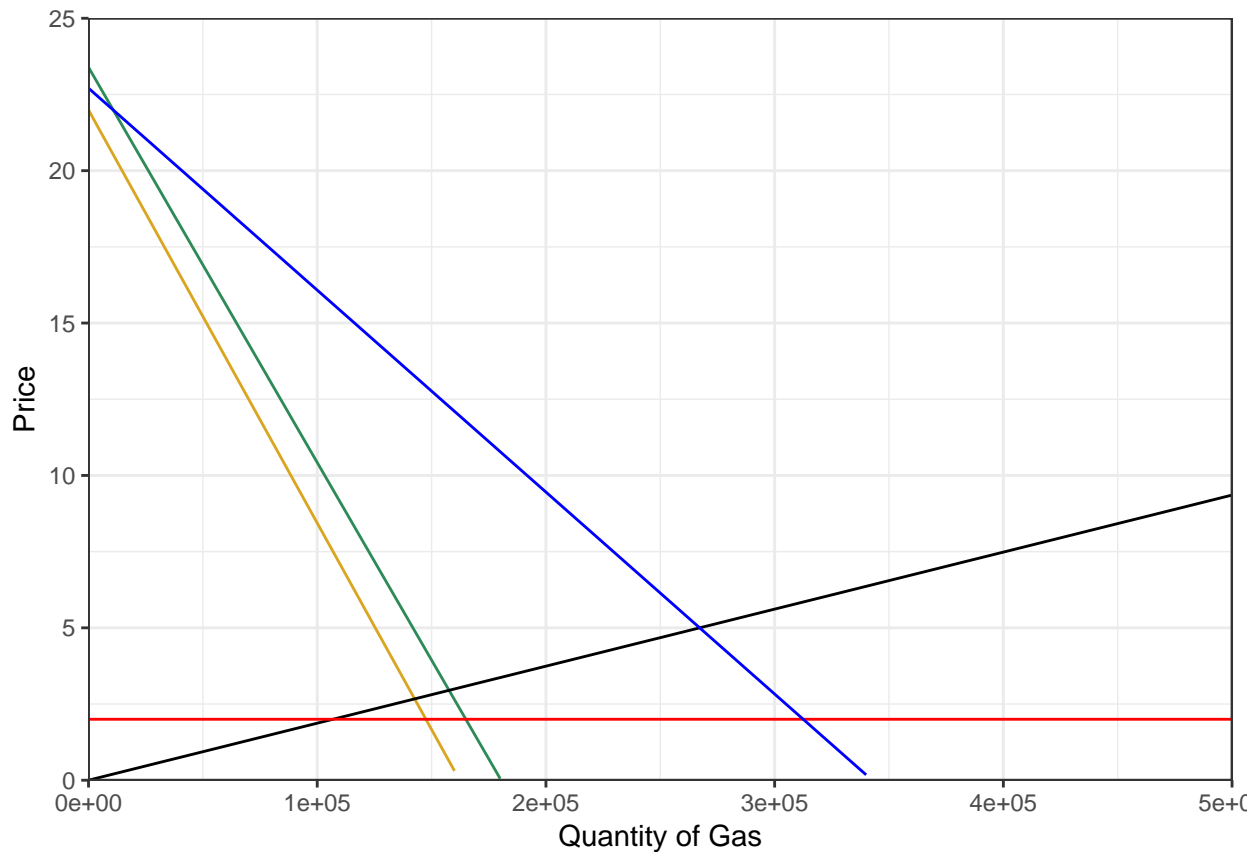
ggplot(data.frame(x=c(70000:200000)), aes(x=x)) +
  stat_function(fun=d_high, geom="line", color="seagreen") +
  stat_function(fun=d_low, geom="line", color="goldenrod") +
  stat_function(fun=mpc, geom="line") +
  stat_function(fun=mec, geom="line", color="red") +
  stat_function(fun=d_agg, geom="line", 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 Demand**  $CS_{High} = (1.3043162 \times 10^6)$

**Consumer Surplus for Low Demand**  $CS_{Low} = (1.0651366 \times 10^6)$