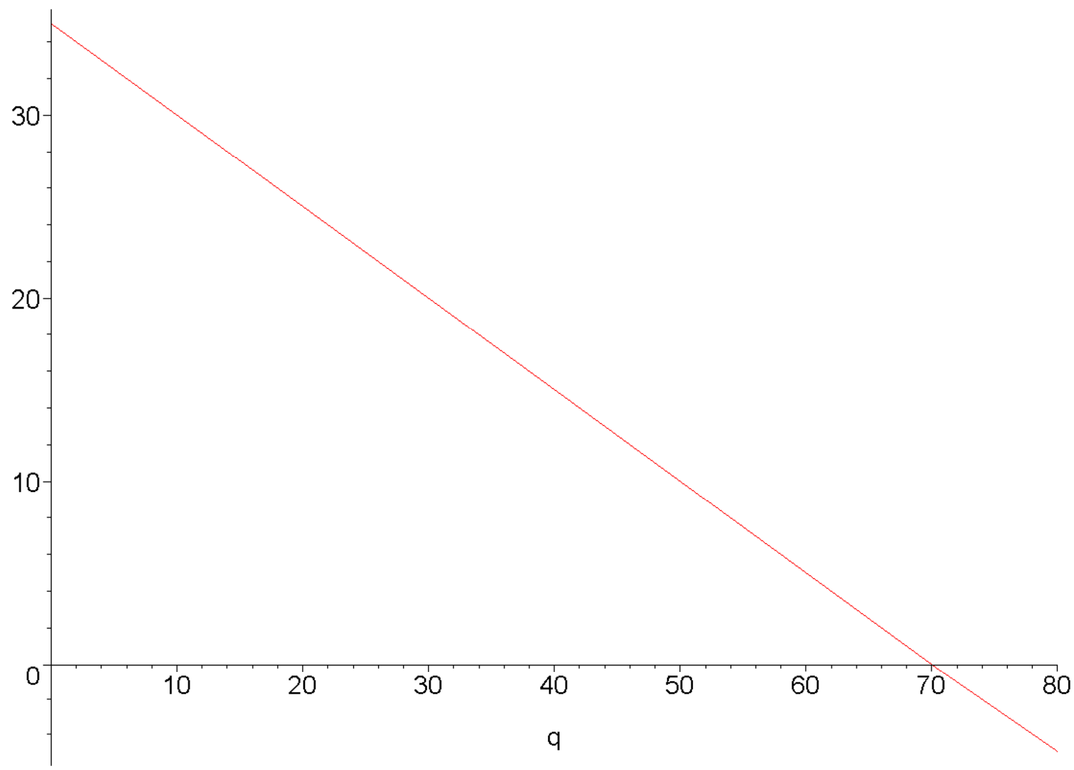
PROBLEM SET #2 - Answer Key

I. a. The demand function looks pretty much like all the ones we've been using in class. First, solve the demand function for p to graph it with q on the horizontal axis and p on the vertical axis:

```
> solve(q=70-2*p,p);
```

$$-\frac{1}{2}q+35$$

```
> plot(-1/2*q+35,q=0..80);
```



To find the range over which this curve is elastic, find the elasticity by using the point-elasticity formula. The derivative of the demand function with respect to p is:

```
> diff(70-2*p,p);
```

$$-2$$

```
>
```

multiplying this by p over q gives the elasticity as:

```
> e[1]:=simplify(-2*(35-1/2*q)/q);
```

$$e_1 := \frac{q-70}{q}$$

To find out the set of points for which this curve is elastic, let's set this equal to negative one and solve. Since elasticity is always decreasing along the length of the curve, we can then reason that all

```
> solve(e[1]=-1,q);
```

$$35$$

So our curve is elastic for all output levels less than 35, and inelastic for all levels of output greater than 35.

I. b. Almost too easy. Since the supply of textbooks is fixed, the quantity demanded cannot exceed 20. Using the above formula, we get the price of textbooks as:

```
> subs(q=20,-1/2*q+35);
```

$$25$$

Elasticity is easily figured out using our formula to be:

```
> subs(q=20, e[1]);
```

$$\frac{-5}{2}$$

```
>
```

To maximize revenue, the bookstore should clearly set production at the point where elasticity is -1. From our above work, this is output = 35.

II. a. Here we have the demand function:

```
> q[d]:=10000-200*p;
```

$$q_d := 10000 - 200\,p$$

and the supply function

```
> q[s]:=300*p;
```

$$q_s := 300\,p$$

Market price is :

```
> solve(q[d]=q[s],p);
```

$$20$$

and market quantity demanded/supplied is:

```
> simplify(subs(p=20,q[d,2]));
```

$$6000$$

b. If the supply changes as described, we get the following:

```
> q[d,2]:=10000-200*p;
```

$$q_{d,2} := 10000 - 200\,p$$

and the supply function

```
> q[s,2]:=-2000+300*p;
```

$$q_{s,2} := -2000 + 300\,p$$

Market price is :

```
> solve(q[d,2]=q[s,2],p);
```

$$24$$

and market quantity demanded/supplied is:

```
> simplify(subs(p=24,q[d,2]));
```

$$5200$$

Diagramatically, we have the following situation:

```
> solve(q=10000-200*p,p);
```

$$-\frac{1}{200}q+50$$

```
> solve(q=300*p,p);
```

$$\frac{1}{300}q$$

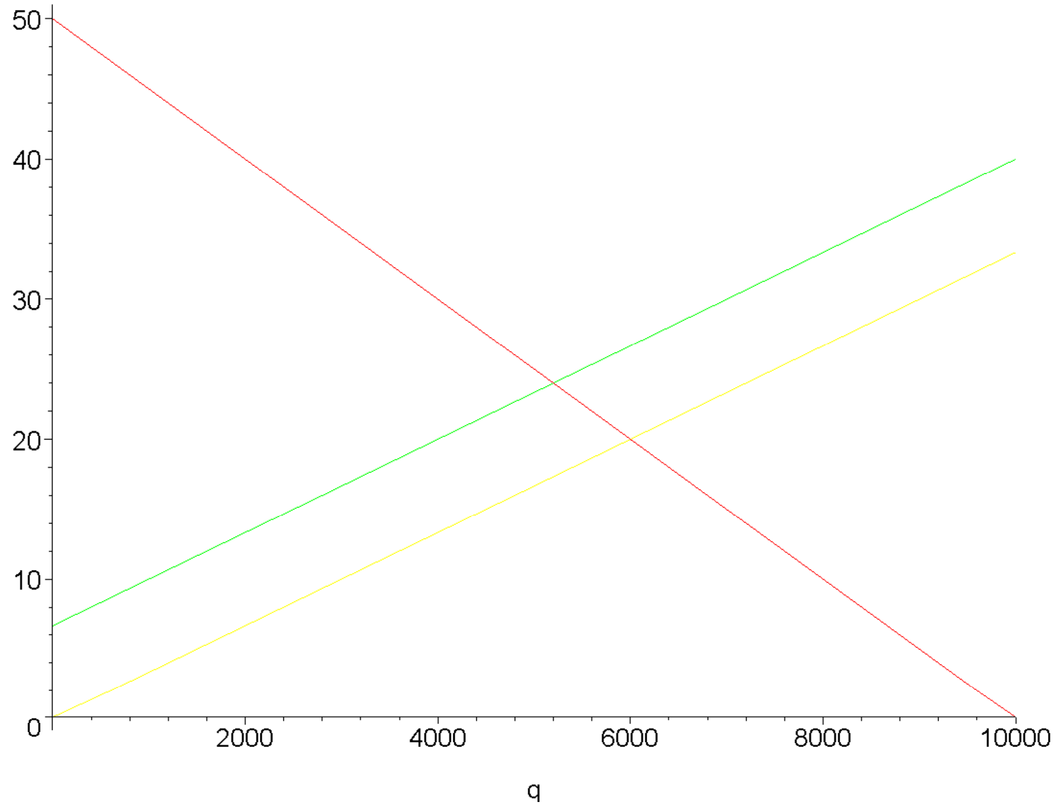
```
> solve(q=10000-200*p,p);
```

$$-\frac{1}{200}q+50$$

```
> solve(q=-2000+300*p,p);
```

$$\frac{1}{300}q+\frac{20}{3}$$

```
> plot({-1/200*q+50,1/300*q,-1/200*q+50,1/300*q+20/3},q=0..10000);
```



Nicely done, wouldn't you say?

II. c. We now have a situation in which demand increases, so the following is true:

```
> q[d]:=14000-200*p;
```

$$q_d := 14000 - 200\,p$$

and the supply function

```
> q[s]:=300*p;
```

$$q_s := 300\,p$$

Market price is :

```
> solve(q[d]=q[s],p);
```

$$28$$

and market quantity demanded/supplied is:

```
> simplify(subs(p=20,q[d,2]));
```

$$6000$$

I'll leave the graph to you!

III. a. In the case in which S=5 and I=25000, we have the following supply and demand functions:

```
> q[d]:=500000+270*I-5000*p;
```

$$q_d := 500000 + 270\, I - 5000\, p$$

```
> q[s]:=-12000+4000*p+10000*S;
```

$$q_s := -12000 + 4000\, p + 10000\, S$$

```
> q[d,1]:=subs(I=25000,q[d]);
```

$$q_{d,\,1} := 7250000 - 5000\, p$$

```
> q[s,1]:=subs(S=5,q[s]);
```

$$q_{s,\,1} := 38000 + 4000\, p$$

```
> solve(q[d,1]=q[s,1],p);
```

$$\frac{2404}{3}$$

```
> R0 := evalf[5](2404/3);
```

$$R0 := 801.33$$

As the equilibrium quantity of oil. The equilibrium quantity supplied/demanded is:

```
> subs(p=801.33,q[d,1]);
```

$$.324335000\ 10^{7}$$

b. In the case in which S=0, we have:

```
> q[d]:=500000+270*I-5000*p;
```

$$q_d := 500000 + 270\, I - 5000\, p$$

```
> q[s]:=-12000+4000*p+10000*S;
```

$$q_s := -12000 + 4000\, p + 10000\, S$$

```
> q[d,1]:=subs(I=25000,q[d]);
```

$$q_{d,\,1} := 7250000 - 5000\, p$$

```
> q[s,1]:=subs(S=0,q[s]);
```

$$q_{s,\,1} := -12000 + 4000\, p$$

```
> solve(q[d,1]=q[s,1],p);
```

$$\frac{7262}{9}$$

```
> R2 := evalf[5](7262/9);
```

$$R2 := 806.89$$

```
> subs(p=806.89,q[d,1]);
```

$$.321555000\ 10^{7}$$

c. If instead we had a safety rating of 10 in the area, the price would be determined as follows:

```
> q[d]:=500000+270*I-5000*p;
```

$$q_d := 500000 + 270\ I - 5000\ p$$

```
> q[s]:=-12000+4000*p+10000*S;
```

$$q_s := -12000 + 4000\ p + 10000\ S$$

```
> q[d,1]:=subs(I=25000,q[d]);
```

$$q_{d,\,1} := 7250000 - 5000\ p$$

```
> q[s,1]:=subs(S=10,q[s]);
```

$$q_{s,\,1} := 88000 + 4000\ p$$

```
> solve(q[d,1]=q[s,1],p);
```

$$\frac{7162}{9}$$

```
> R3 := evalf[5](7162/9);
```

$$R3 := 795.78$$

d. Here we just plug in the different numbers, along with the new income level, to get:

```
> q[d]:=500000+270*I-5000*p;
```

$$q_d := 500000 + 270\ I - 5000\ p$$

```
> q[s]:=-12000+4000*p+10000*S;
```

$$q_s := -12000 + 4000\ p + 10000\ S$$

```
> q[d,1]:=subs(I=20000,q[d]);
```

$$q_{d,\,1} := 5900000 - 5000\ p$$

```
> q[s,1]:=subs(S=5,q[s]);
```

$$q_{s,\,1} := 38000 + 4000\ p$$

```
> solve(q[d,1]=q[s,1],p);
```

$$\frac{1954}{3}$$

```
> R4 := evalf[5](1954/3);
```

$$R4 := 651.33$$

Which is quite a substantial drop in oil prices. Elasticity is computed by using the point formula and we can get for demand with respect to prices:

```
> diff(q[d],p);
```

$$-5000$$

```
> solve(q=500000+270*I-5000*p,p);
```

$$-\frac{1}{5000}\,q + 100 + \frac{27}{500}\,I$$

```
> e[d]:=-5000*(-1/5000*q+100+27/500*I);
```

$$e_d := q - 500000 - 270\, I$$

```
> diff(q[s],p);
```

$$4000$$

```
> solve(q=-12000+4000*p+10000*S,p);
```

$$\frac{1}{4000} q + 3 - \frac{5}{2} S$$

```
> e[s]:=4000*(1/4000*q+3-5/2*S);
```

$$e_s := q + 12000 - 10000\, S$$

```
> diff(q[s],S);
```

$$10000$$

```
> solve(q=-12000+4000*p+10000*S,S);
```

$$\frac{1}{10000} q + \frac{6}{5} - \frac{2}{5} p$$

```
> e[S]:=10000*(1/10000*q+6/5-2/5*p);
```

$$e_S := q + 12000 - 4000\, p$$

Policy makers might want to know whether the supply of oil will respond sharply to an intervention in the middle east, or they may want to know how the total amount consumers spend on oil changes, for example.

IV. a) here we have:

```
> q[d,pl]:=1000-10*p[pl]-2*p[cd];
```

$$q_{d,\, pl} := 1000 - 10\, p_{pl} - 2\, p_{cd}$$

```
> q[d,cd]:=200-p[cd]-1/5*p[pl];
```

$$q_{d,\, cd} := 200 - p_{cd} - \frac{1}{5} p_{pl}$$

```
> q[s,pl]:=50+2*p[pl];
```

$$q_{s,\, pl} := 50 + 2\, p_{pl}$$

```
> q[s,cd]:=100+4*p[cd];
```

$$q_{s,\, cd} := 100 + 4\, p_{cd}$$

Our equilibrium prices are given by:

```
> solve({q[d,pl]=q[s,pl],q[d,cd]=q[s,cd]},{p[cd],p[pl]});
```

$$\{p_{cd} = \frac{2525}{149}, p_{pl} = \frac{11375}{149}\}$$

Our elasticity formula is as follows:

```
> solve(q=200-p[cd]-1/5*p[pl],p[cd]);
```

$$-q + 200 - \frac{1}{5} p_{pl}$$

```
> diff(q[d,cd],p[cd]);
```

$$-1$$

```
> e[d]:=-1*(-q+200-1/5*p[pl]);
```

$$e_d := q - 200 + \frac{1}{5} p_{pl}$$

```
> q[d,pl]:=1200-10*p[pl]-2*p[cd];
```

$$q_{d,\,pl} := 1200 - 10\, p_{pl} - 2\, p_{cd}$$

```
> q[d,cd]:=200-p[cd]-1/5*p[pl];
```

$$q_{d,\,cd} := 200 - p_{cd} - \frac{1}{5} p_{pl}$$

```
> q[s,pl]:=50+2*p[pl];
```

$$q_{s,\,pl} := 50 + 2\, p_{pl}$$

```
> q[s,cd]:=100+4*p[cd];
```

$$q_{s,\,cd} := 100 + 4\, p_{cd}$$

```
> solve({q[d,pl]=q[s,pl],q[d,cd]=q[s,cd]},{p[cd],p[pl]});
```

$$\{p_{cd} = \frac{2425}{149}, p_{pl} = \frac{13875}{149}\}$$

```
>
```