Assignment 3

December 8, 2018

In [11]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
sns.set()
```

In [14]:
```
Income = 200
Pas = [5, 10, 15, 20]
Pb = 40
Qa = np.arange(0,11,0.5)
Qb = [((Income)/(Pb)) - ((Pa*Qa)/(Pb)) for Pa in Pas]
df = pd.DataFrame(list(zip(Qa,Qb[0],Qb[1],Qb[2],Qb[3])),
                  columns=['Quantity of Product A'] +
                          ['Quantity of Product B at Price A = {}'.format(Pa) for Pa
print(df)
```

```
    Quantity of Product A  Quantity of Product B at Price A = 5  \
0                     0.0                                5.0000
1                     0.5                                4.9375
2                     1.0                                4.8750
3                     1.5                                4.8125
4                     2.0                                4.7500
5                     2.5                                4.6875
6                     3.0                                4.6250
7                     3.5                                4.5625
8                     4.0                                4.5000
9                     4.5                                4.4375
10                    5.0                                4.3750
11                    5.5                                4.3125
12                    6.0                                4.2500
13                    6.5                                4.1875
14                    7.0                                4.1250
15                    7.5                                4.0625
16                    8.0                                4.0000
17                    8.5                                3.9375
18                    9.0                                3.8750
19                    9.5                                3.8125
```

20	10.0	3.7500
21	10.5	3.6875

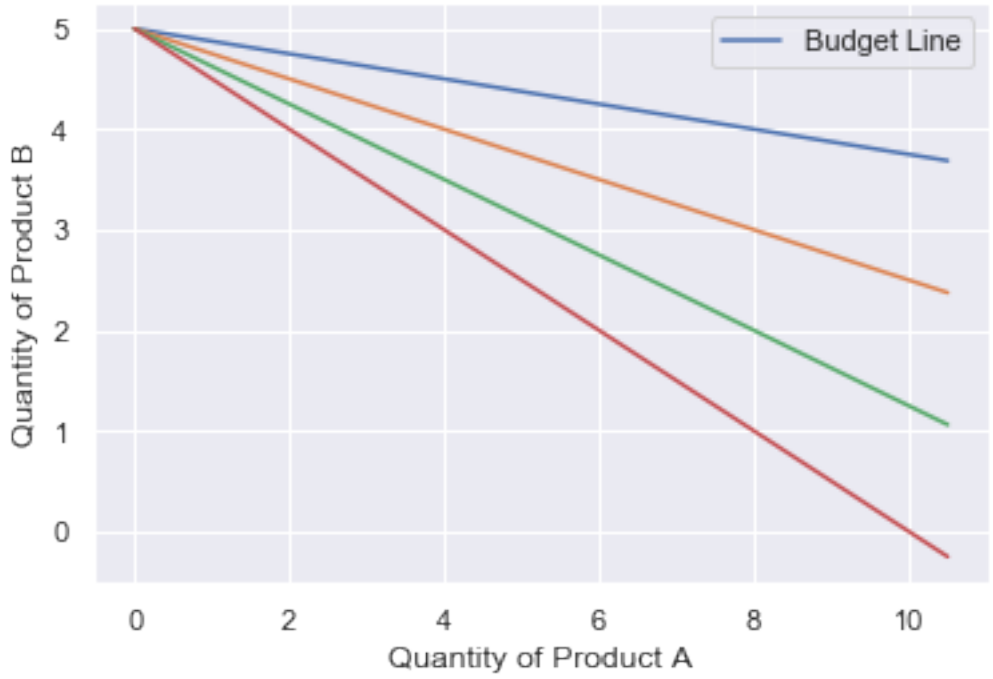
	Quantity of Product B at Price A = 10 \
0	5.000
1	4.875
2	4.750
3	4.625
4	4.500
5	4.375
6	4.250
7	4.125
8	4.000
9	3.875
10	3.750
11	3.625
12	3.500
13	3.375
14	3.250
15	3.125
16	3.000
17	2.875
18	2.750
19	2.625
20	2.500
21	2.375

	Quantity of Product B at Price A = 15 \
0	5.0000
1	4.8125
2	4.6250
3	4.4375
4	4.2500
5	4.0625
6	3.8750
7	3.6875
8	3.5000
9	3.3125
10	3.1250
11	2.9375
12	2.7500
13	2.5625
14	2.3750
15	2.1875
16	2.0000
17	1.8125
18	1.6250
19	1.4375

```
20                                  1.2500
21                                  1.0625

    Quantity of Product B at Price A = 20
0                                    5.00
1                                    4.75
2                                    4.50
3                                    4.25
4                                    4.00
5                                    3.75
6                                    3.50
7                                    3.25
8                                    3.00
9                                    2.75
10                                   2.50
11                                   2.25
12                                   2.00
13                                   1.75
14                                   1.50
15                                   1.25
16                                   1.00
17                                   0.75
18                                   0.50
19                                   0.25
20                                   0.00
21                                  -0.25
```

```
In [8]: [plt.plot(df['Quantity of Product A'], df['Quantity of Product B at Price A = {}'.forma
        plt.xlabel('Quantity of Product A')
        plt.ylabel('Quantity of Product B')
        plt.legend(['Budget Line'])
        plt.show()
```




```
In [15]: x = np.arange(1, 10.1, 0.1)
         indifference_curve = lambda x: 25/(2*x)
         for Pa in Pas:
             df['Indifference Curve at Pa = {}'.format(Pa)] = indifference_curve(df['Quantity
         print(df)
```

```
    Quantity of Product A  Quantity of Product B at Price A = 5  \
0                     0.0                                5.0000
1                     0.5                                4.9375
2                     1.0                                4.8750
3                     1.5                                4.8125
4                     2.0                                4.7500
5                     2.5                                4.6875
6                     3.0                                4.6250
7                     3.5                                4.5625
8                     4.0                                4.5000
9                     4.5                                4.4375
10                    5.0                                4.3750
11                    5.5                                4.3125
12                    6.0                                4.2500
13                    6.5                                4.1875
14                    7.0                                4.1250
15                    7.5                                4.0625
16                    8.0                                4.0000
```

17	8.5	3.9375
18	9.0	3.8750
19	9.5	3.8125
20	10.0	3.7500
21	10.5	3.6875

	Quantity of Product B at Price A = 10 \
0	5.000
1	4.875
2	4.750
3	4.625
4	4.500
5	4.375
6	4.250
7	4.125
8	4.000
9	3.875
10	3.750
11	3.625
12	3.500
13	3.375
14	3.250
15	3.125
16	3.000
17	2.875
18	2.750
19	2.625
20	2.500
21	2.375

	Quantity of Product B at Price A = 15 \
0	5.0000
1	4.8125
2	4.6250
3	4.4375
4	4.2500
5	4.0625
6	3.8750
7	3.6875
8	3.5000
9	3.3125
10	3.1250
11	2.9375
12	2.7500
13	2.5625
14	2.3750
15	2.1875
16	2.0000

17	1.8125
18	1.6250
19	1.4375
20	1.2500
21	1.0625

	Quantity of Product B at Price A = 20	Indifference Curve at Pa = 5 \
0	5.00	2.500000
1	4.75	2.531646
2	4.50	2.564103
3	4.25	2.597403
4	4.00	2.631579
5	3.75	2.666667
6	3.50	2.702703
7	3.25	2.739726
8	3.00	2.777778
9	2.75	2.816901
10	2.50	2.857143
11	2.25	2.898551
12	2.00	2.941176
13	1.75	2.985075
14	1.50	3.030303
15	1.25	3.076923
16	1.00	3.125000
17	0.75	3.174603
18	0.50	3.225806
19	0.25	3.278689
20	0.00	3.333333
21	-0.25	3.389831

	Indifference Curve at Pa = 10	Indifference Curve at Pa = 15 \
0	2.500000	2.500000
1	2.564103	2.597403
2	2.631579	2.702703
3	2.702703	2.816901
4	2.777778	2.941176
5	2.857143	3.076923
6	2.941176	3.225806
7	3.030303	3.389831
8	3.125000	3.571429
9	3.225806	3.773585
10	3.333333	4.000000
11	3.448276	4.255319
12	3.571429	4.545455
13	3.703704	4.878049
14	3.846154	5.263158
15	4.000000	5.714286
16	4.166667	6.250000

```
17                        4.347826                        6.896552
18                        4.545455                        7.692308
19                        4.761905                        8.695652
20                        5.000000                       10.000000
21                        5.263158                       11.764706

    Indifference Curve at Pa = 20
0                         2.500000
1                         2.631579
2                         2.777778
3                         2.941176
4                         3.125000
5                         3.333333
6                         3.571429
7                         3.846154
8                         4.166667
9                         4.545455
10                        5.000000
11                        5.555556
12                        6.250000
13                        7.142857
14                        8.333333
15                       10.000000
16                       12.500000
17                       16.666667
18                       25.000000
19                       50.000000
20                             inf
21                      -50.000000
```

```
In [39]: fig, ax = plt.subplots(ncols=1, nrows=2, figsize=(10,15))
         for Pa in Pas:
             ax[0].plot(df['Quantity of Product A'], df['Quantity of Product B at Price A = {}
         for i in np.arange(1,2,0.25):
             ax[0].plot(x+i-1, i*indifference_curve(x))
             ax[0].scatter([5+i-1],indifference_curve(5+i-1)+3*(i-1), marker='x')
         ax[0].set_xlabel('Quantity of Product A')
         ax[0].set_ylabel('Quantity of Product B')
         ax[0].set_ylim(0, 20)
         ax[0].legend(['Indifference Curve', 'Budget Line', 'Equilibrium point (Qa = 5, Qb = 2

         for Pa in Pas:
             ax[1].plot(df['Quantity of Product A'], df['Quantity of Product B at Price A = {}
         ax[1].plot(x, indifference_curve(x))
         ax[1].scatter([5],indifference_curve(5), marker='x')
         ax[1].set_xlabel('Quantity of Product A')
         ax[1].set_ylabel('Quantity of Product B')
```

```
ax[1].legend(['Indifference Curve', 'Budget Line', 'Equilibrium point (Qa = 5, Qb = 2
ax[1].set_ylim(2,3)
ax[1].set_xlim(4,6)
plt.show()
```