LopezL_Wk6

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1 Week 6 Worksheet

1.1 Linear Programming

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[ ]:
```
import numpy as np
import matplotlib.pyplot as plt
import pandas as pd
from IPython.display import display
```

[ ]:
```
# Define the data
data = {
    'Parameter': ['Profit from pizza', 'Profit from sandwich', 'Time for␣
 ↪pizza', 'Time for sandwich', 'Total time', 'Quantity'],
    'Value/Expression': ['$25', '$15', '8 minutes', '3 minutes', '60 minutes',␣
 ↪'10 items']
}

# Create a DataFrame
df = pd.DataFrame(data)

# Display the DataFrame as a table
display(df)
```

	Parameter	Value/Expression
0	Profit from pizza	$25
1	Profit from sandwich	$15
2	Time for pizza	8 minutes
3	Time for sandwich	3 minutes
4	Total time	60 minutes
5	Quantity	10 items

To Maximize profits, we should balance the number of sandwiches and pizzas so that we have **6 pizzas** and **4 sandwiches**

Pizza(x) = sell for $50, cost $25 = $25
Sandwiches(y) = sell for $20, cost $5 = $15

P(x,y) = 25x + 15y

Time Constraint: 8x + 3y = <= 60
Quantity Constraint: x + y = 10

1.2 Time Constraint:

8x + 3y = 60
3y = 60 - 8x
y = (60 - 8x)/3
y = 20 - (8/3)x

1.3 Quantity Constraint:

x + y = 10
y = 10 - x

1.4 Intersection:

8x + 3(10 - x) = 60
8x + 30 - 3x = 60
5x = 30
x = 6

y = 10 - 6 = 4

1.5 Pizzas only

Time constraint: x = 60/8 = 7.5, round to 7
y = 0
x = 10
P(7,0) = 25(7) + 15(0) = 175

1.6 Sandwiches only

Time constraint: x = 60/3 = 20, but we can only make 10 y = 10 x = 0 P(0,10) = 25(0) + 12 (10) = 150

1.7 Balanced option

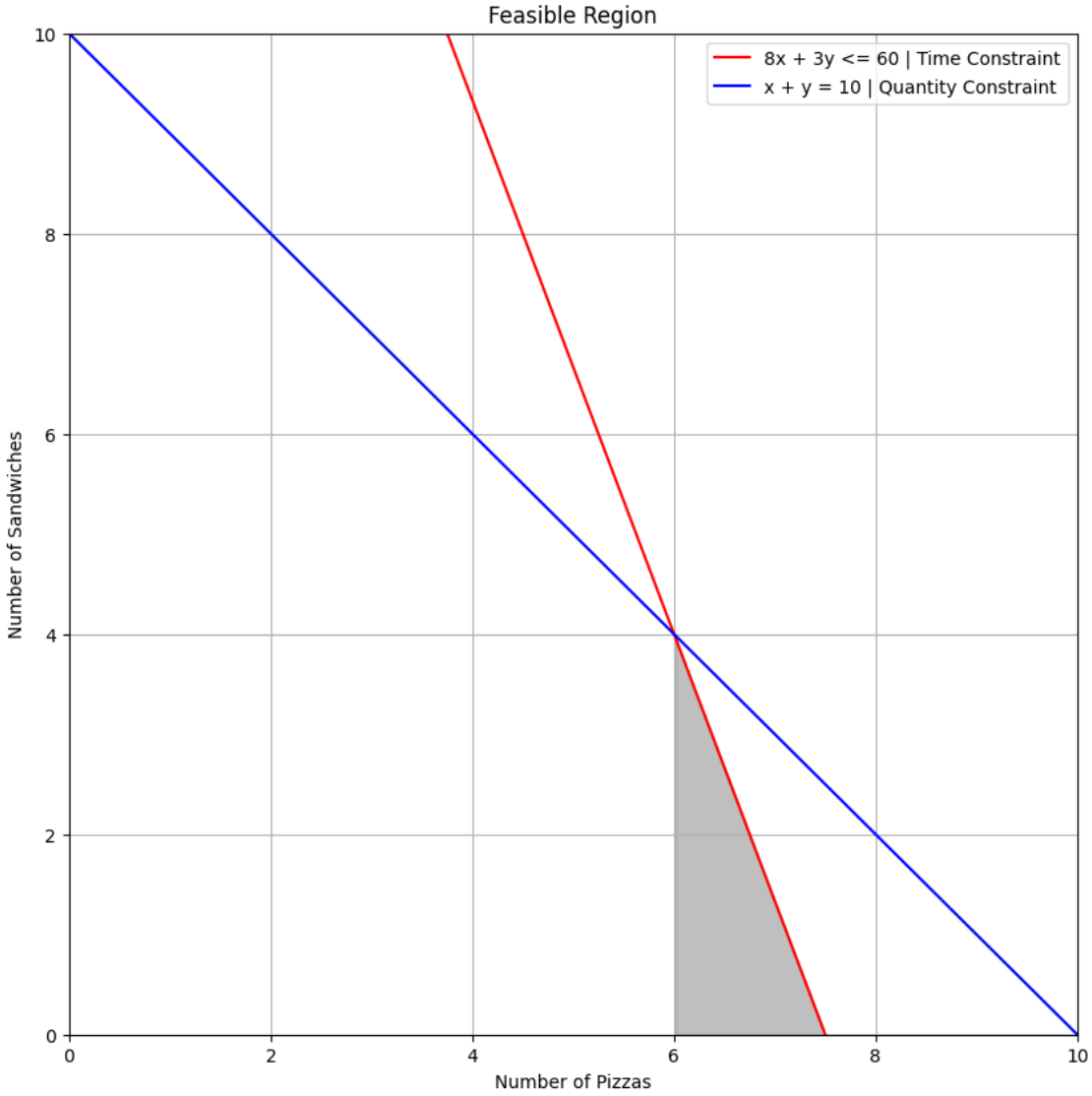
Quantity constraint: x + y = 10
y = 10 - x
plug into time constraint
8x + 3(10 - x) = 60
8x + 30 - 3x = 60
5x + 30 = 60
5x = 30
x = 6
y = 10 - 6
y = 4

x = 6, y = 4
P(6,4) = 25(6) + 15(4) = 150 + 60 = 210

1.8 Conclusion

Given the time constraints and quantity constraints, a balanced approach is the best approach.
If we could only do pizzas, without time constraints, we could do 10 pizzas at $25 = $250.
If we could only do sandwiches, without the quantity constraints, we could do 20 sandwiches at $15 = $300.
Because of our constraints, the best option is the Balanced Option, 6 pizzas and 4 sandwiches, at $210.

[ ]:
```
# Generate x values
x = np.linspace(0, 10, 400)

y1 = (60 - 8*x)/3 # Time constraint, 8x + 3y = 60 -> (60 - 8x) / 3
y2 = 10 - x # Quantity constraint, x + y = 10 -> y = 10 - x

plt.figure(figsize=(10,10))

# Plotting constraints
plt.plot(x, y1, '-r', label="8x + 3y <= 60 | Time Constraint")
plt.plot(x, y2, '-b', label="x + y = 10 | Quantity Constraint")
plt.fill_between(x, 0, y1, where = ((y1<=y2) & (x<=10)), color = 'gray', alpha␣
↪= 0.5)

# Setting the labels and title
plt.title("Feasible Region")
plt.xlabel("Number of Pizzas")
plt.ylabel("Number of Sandwiches")
plt.xlim((0, 10))
plt.ylim((0, 10))

# Adding the legend
plt.legend()

# Adding grid
plt.grid(True)

# Showing the plot
plt.show()
```


Feasible Region
8x + 3y <= 60 | Time Constraint
x + y = 10 | Quantity Constraint
Number of Sandwiches
Number of Pizzas
0
2
4
6
8
10