Lesson 8 Supplement: Excel and Multiple Optimal Solutions

1 Today...

- read and write to Excel from Python using pandas, xlrd, xlwrt
- test for multiple optimal soluitons

2 Main lesson

The main lesson for today is in a Jupyter notebook. We will just collect some useful ideas here for easy access.

3 pandas: commonly used commands

- Import pandas:

```
import pandas as pd
```

- Import numpy:

```
import numpy as np
```

- Import xlrd:

```
import xlrd
```

- Import xlwrt:

```
import xlwrt
```

- Import XlsxWriter:

```
import xlsxwriter
```

- Open an existing Excel file called "FileName.xlsx":

```
df = pd.read_excel ('FileName.xlsx')
```

Note: This only works if the Python file (Jupyter notebook) and the Excel file are in the same directory. Otherwise, we need the full path to the Excel file in quotes.

Another Note: pandas will always assign labels to rows and columns, so you that you reference the number row/column or the name of that row/column. It will automatically assign a numeric label of zero. If you have a better way to label columns, then you can set 'index_col=value' to some column value.

- Open a specific sheet:

```
df = pd.read_excel(r'File_name.xlsx', sheet_name='Sheet_Name')
```

- Importingonly a subset of columns:

```
data = pd.read_excel ('FileName.xlsx')
df = pd.DataFrame(data, columns= ['ColumnName'])
```

- If you want to combine multiple sheets of data from 'Sheet_Name_1', 'Sheet_Name_3', 'Sheet_Name_3':

```
df = pd.read_excel(r'File_name.xlsx', sheet_name='Sheet_Name_1')
df2 = pd.read_excel(r'File_name.xlsx', sheet_name='Sheet_Name_2')
df3 = pd.read_excel(r'File_name.xlsx', sheet_name='Sheet_Name_3')
combined_values = pd.concat([df,df2,df3,])
```

- Exporting a DataFrame to Excel:

```
df.to_excel('output.xlsx')
```

4 Other Python reminders

- We can use a `range()` object in `for` loops. For example,

```
for i in range(3):
```

  loops over $i = 0, 1, 2$.

- Recall that list indexing always starts at 0.
- To index over the list of lists,

```
mylist = [[a,b,c],[d,e,f]],
```

  the item at position

```
mylist[0][1]
```

  is b (list 0, position 1).

5 Multiple Optimal Solutions

Sometimes we might want to explore different optimal solutions to the same integer or linear program. This means, a solution that has the same objective value, but different values for the variables. In order to accomplish this, we can take the following steps:

1. Solve the model the first time
2. Add a constraint to the model that prevents the same optimal solution from occuring
   - We have to be careful not to make the constraint too restrictive, or it may prevent other optimal solutions from occuring.
3. Solve the model again and see what happens
   - If we get another optimal solution with the same objective value, then the model has multiple optimal solutions. We can add yet another constraint to check for a third optimal solution, etc.
   - If we get infeasible or an optimal solution with a worse objective value, then there was only the one optimal solution.
   - Is it possible to add a constraint to the model and get a better better optimal objective value?