

Assignment 8

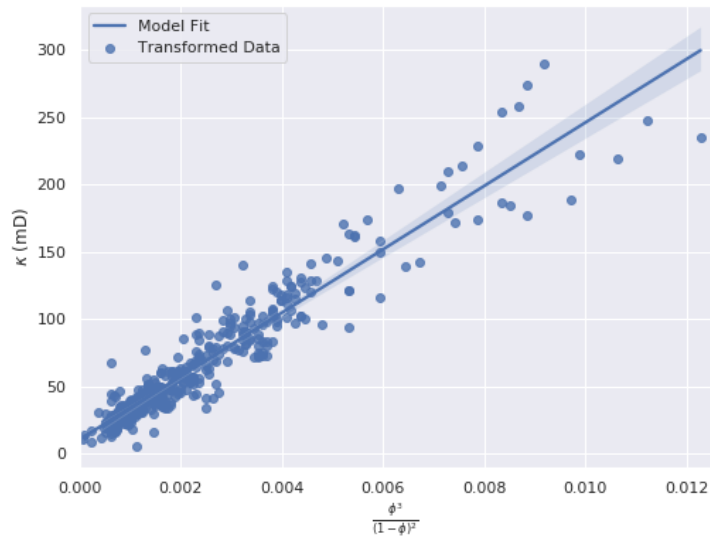
The Kozeny-Carmen (K-C) relationship is a model that relates porosity to permeability through a proportionality constant

$$m \propto \frac{\phi^3}{(1-\phi)^2} = f(\phi)$$

The file `poro_perm.csv` contains two columns of data corresponding to porosity and permeability measurements for a reservoir. Your assignment is to implement the `kc_model` member function below to return $f(\phi)$ as defined above.

I have already provided the code to read in the data file. It stores the permeability and porosity as attributes of the class `KozenyCarmen` which you can use to implement `kc_model`. Use NumPy *broadcasting* operations to make your code compact and readable. `kc_model` should return a NumPy array. The tests will fail if it returns a Python list or any other type of data structure.

For convenience, I've implemented a `plot` member function so you can see the transformation of the data along with a fit to the Kozeny-Carmen model (and error bounds). This is just for visualization purposes, you should not edit any code in this member function. If `kc_model` is implemented correctly, it should return a plot that looks like



If you'd like to produce this plot in the notebook, simply run

```
KozenyCarmen('poro_perm.csv').plot()
```

in a code cell.

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

def read_xlsx(filename):
    #Read xlsx file into numpy array
    #stores the columns of the data as
    #porosity and permeability

    df = pd.read_excel(filename)
    df_np = np.array(df)
    perm_measured = df_np[:,1]
    poro_measured = df_np[:,0]

    return poro_measured, perm_measured

def kc_model(porosity):
    #This function should return f(phi) as defined above

    perm_kc = porosity ** 3 / ((1 - porosity)**2)

    return perm_kc

def plot_comparsion(phi,k_exp):
    #Does not need to change if kc_model() is implemented properly
    fig, ax = plt.subplots(figsize=(8,6))
    sns.regplot(kc_model(phi), k_exp, ax=ax)
    ax.set_xlabel(r'$\frac{\phi^3}{(1-\phi)^2}$')
    ax.set_ylabel(r'$\kappa$ (mD)')
    ax.set_xlim([0, 0.0125])
    ax.legend(['Model Fit', 'Transformed Data'])
```

```
In [ ]: # Uncomment to test code in notebook
poro_measured, perm_measured = read_xlsx('poro_perm.xlsx')
plot_comparsion(poro_measured,perm_measured)
```

F:\Anaconda\lib\site-packages\seaborn\decorators.py:36: FutureWarning: Pass the following variables as keyword args: x, y. From version 0.12, the only valid positional argument will be `data`, and passing other arguments without an explicit keyword will result in an error or misinterpretation.

```
warnings.warn(
```

