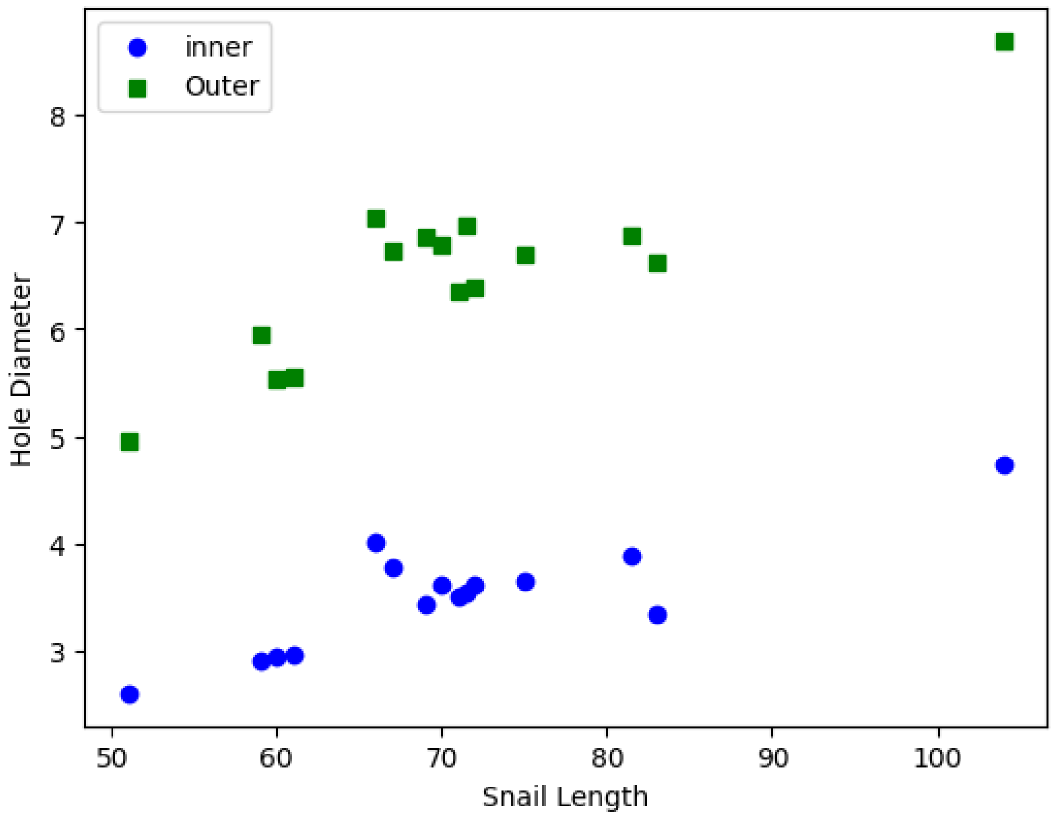
```python
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
from sklearn.linear_model import LinearRegression

drill = pd.read_csv("Drilling.csv")
print(drill)
```

```
    Length  Outer  Inner
0     51.0   4.95   2.60
1     59.0   5.95   2.91
2     60.0   5.53   2.94
3     61.0   5.55   2.97
4     66.0   7.04   4.01
5     67.0   6.73   3.77
6     69.0   6.86   3.44
7     70.0   6.78   3.61
8     71.0   6.35   3.51
9     71.5   6.97   3.55
10    72.0   6.39   3.61
11    75.0   6.70   3.65
12    81.5   6.88   3.88
13    83.0   6.63   3.35
14   104.0   8.69   4.73
```

independent variable is the length and the dependent variables are the outer and inner diameter of the driller holes.Sample Size is 13

```python
x = drill['Length']
yi = drill['Inner']
yo = drill['Outer']
X = x.to_numpy().reshape(-1, 1)
plt.scatter(x,yi,color='b',marker = 'o',label = 'inner')
plt.scatter(x,yo,color='g',marker = 's',label = 'Outer')
plt.legend(loc = 'upper left')
plt.xlabel('Snail Length')
plt.ylabel('Hole Diameter')
```

```
Text(0, 0.5, 'Hole Diameter')
```




```
# Linear regression for inner diameter
ri = LinearRegression()
ri.fit(X, yi)
print('Inner Diameter Model Intercept = ', ri.intercept_)
print('Inner Diameter Model Slope = ', ri.coef_[0])

Inner Diameter Model Intercept =  1.0107609847495889
Inner Diameter Model Slope =  0.03522015572927066
```

Model intercept = 1.0107609847495889 Model slope = 0.03522015572927066

```
ro = LinearRegression()
ro.fit(X,yo)
print('Model intercept = ', ro.intercept_)
print('Model slope = ', ro.coef_[0])

Model intercept =  2.2305961943083554
Model slope =  0.06083040253098459
```

Model intercept = 2.2305961943083554 Model slope = 0.06083040253098459

```
si = ri.score(X,yi)
print('R2 coefficient = ',si)
```

```
R2 coefficient =  0.7051244459260384
```

```python
so = ro.score(X,yo)
print('R2 coefficient = ',so)
```

```
R2 coefficient =  0.7769404150243147
```

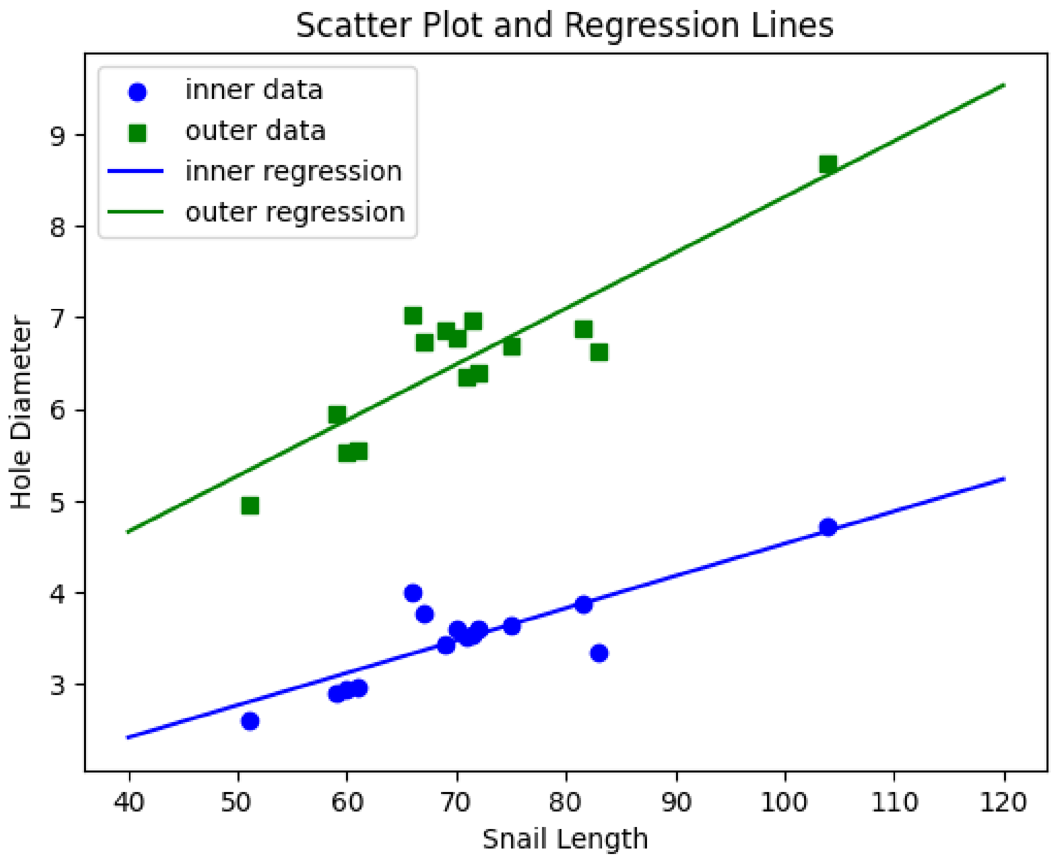
R2 coefficient for inner = 0.7051244459260384 R2 coefficient for outer = 0.7769404150243147

```python
xp = np.array([40,120])
Xp = xp.reshape(-1,1)
yip = ri.predict(Xp)
yop = ro.predict(Xp)
print(yip)
print(yop)
```

```
[2.41956721 5.23717967]
[4.6638123 9.5302445]
```

```python
plt.scatter(x,yi,color='b',marker='o',label='inner data')
plt.scatter(x,yo,color='g',marker='s',label='outer data')
plt.plot(xp,yip,color='b',label='inner regression')
plt.plot(xp,yop,color='g',label='outer regression')
plt.legend(loc='upper left')
plt.xlabel('Snail Length')
plt.ylabel('Hole Diameter')
plt.title('Scatter Plot and Regression Lines')
```

```
Text(0.5, 1.0, 'Scatter Plot and Regression Lines')
```




```
Snail_Length12 = np.array([120]).reshape(-1, 1)
inner_diameter_pred = ri.predict(Snail_Length12)
outer_diameter_pred = ro.predict(Snail_Length12)
print('Inner Diameter for Snail Length 120 mm(predicted)= ',
inner_diameter_pred)
print('Outer Diameter for Snail Length 120 mm(predicted)= ',
outer_diameter_pred)

Inner Diameter for Snail Length 120 mm(predicted)=  [5.23717967]
Outer Diameter for Snail Length 120 mm(predicted)=  [9.5302445]
```

yes the values makes sense to me as 12cm = 120mm and if we calculate for that it gives me
Predicted Inner Diameter for Snail Length 120 mm =
5.23717967

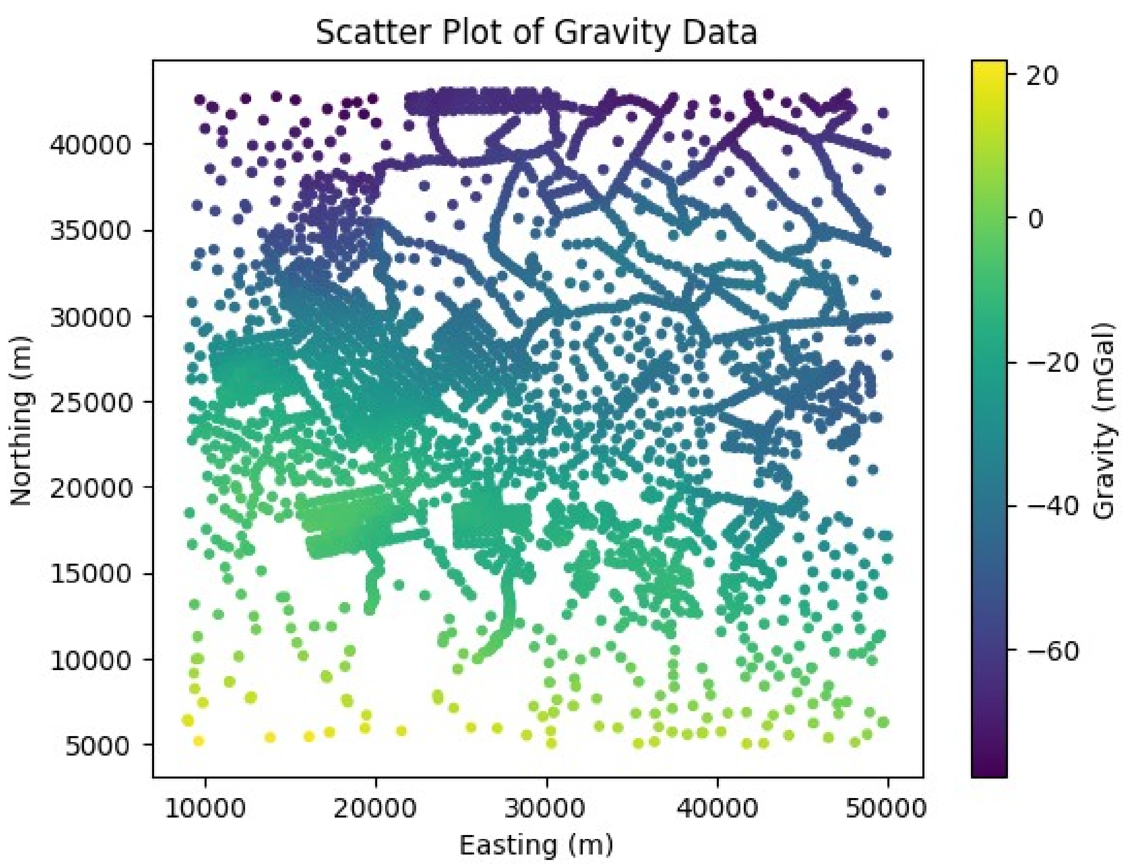
Predicted Outer Diameter for Snail Length 120 mm =
9.5302445

```
grav = pd.read_csv("Gravity.csv")
print(grav)

      Easting  Northing  Elevation  VerticalGravity
0     47910.0   22759.0     376.26       -45.418361
```

```
1     49140.0   21000.0     417.40       -42.201259
2     27677.0   14177.0     317.54       -12.955121
3     27686.0   14275.0     318.50       -13.213383
4     27706.0   14372.0     321.32       -13.472344
...       ...       ...        ...              ...
2912  12039.0   33650.0     276.22       -50.032747
2913  10559.0   33840.0     340.40       -49.083186
2914  10779.0   32650.0     363.00       -45.046169
2915  49990.0   17147.0     389.08       -30.409357
2916  38120.0   35389.0     318.62       -40.409906

[2917 rows x 4 columns]
```

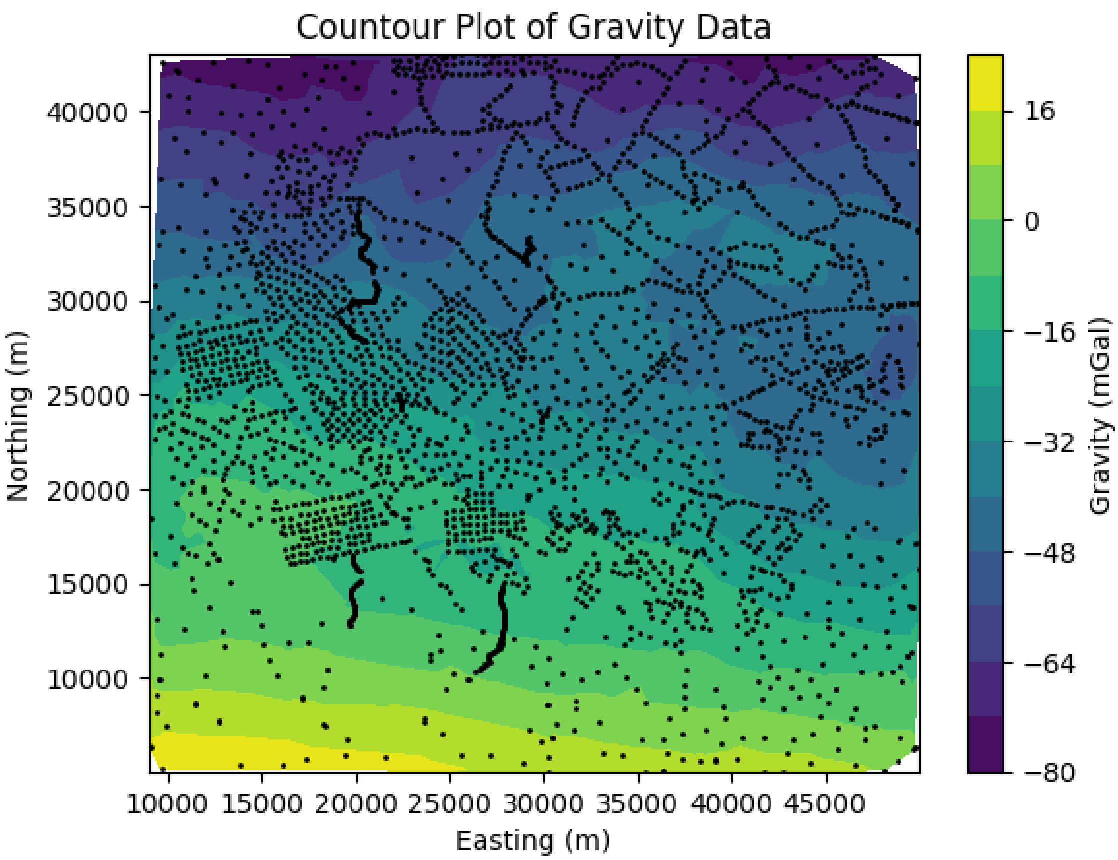
```python
X = grav[['Easting','Northing']]
f = grav['VerticalGravity']
plt.scatter(X['Easting'],X['Northing'],10,f)
plt.xlabel('Easting (m)')
plt.ylabel('Northing (m)')
cbar = plt.colorbar()
cbar.set_label('Gravity (mGal)')
plt.title('Scatter Plot of Gravity Data')
```

```
Text(0.5, 1.0, 'Scatter Plot of Gravity Data')
```



```
plt.tricontourf(X['Easting'],X['Northing'],f,15)
cbar = plt.colorbar()
cbar.set_label('Gravity (mGal)')
plt.scatter(X['Easting'],X['Northing'],1,'black')
plt.xlabel('Easting (m)')
plt.ylabel('Northing (m)')
plt.title('Countour Plot of Gravity Data')
```

```
Text(0.5, 1.0, 'Countour Plot of Gravity Data')
```




```
reg2 = LinearRegression()
reg2.fit(X,f)
a, b = reg2.coef_
c = reg2.intercept_

# Print the results
print('Coefficients (a, b): ', a, b)
print('Intercept (c): ', c)
```

```
Coefficients (a, b):  -0.00039999998064438005 -0.0020000000190392164
Intercept (c):  30.894456575577024
```

```
trend = reg2.predict(X)
print(trend)
```

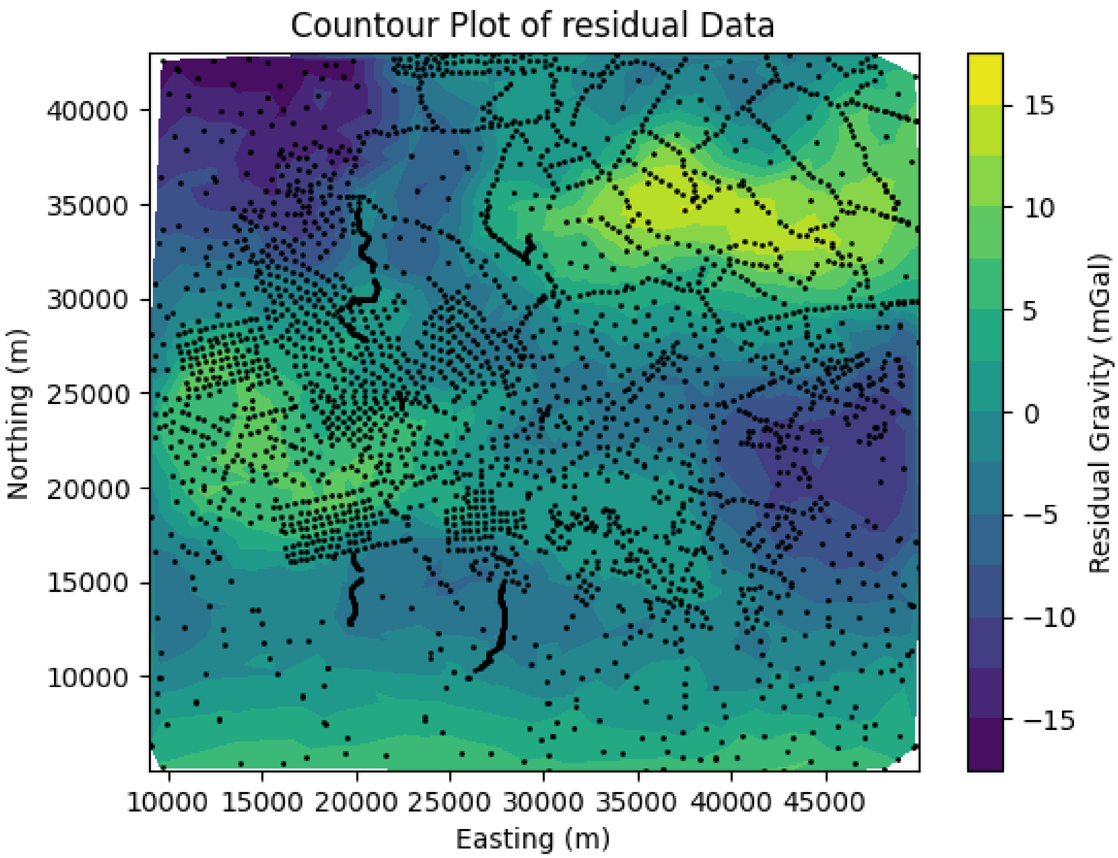
```
[-33.78754293 -30.76154287  -8.53034316 ... -38.71714384 -23.39554278
 -55.13154336]
```

```
residual = f - trend
print(residual)
```

```
0      -11.630819
1      -11.439716
2       -4.424778
3       -4.483440
4       -4.540401
          ...
2912    -8.811603
2913    -8.074043
2914    -6.329025
2915    -7.013814
2916    14.721637
Name: VerticalGravity, Length: 2917, dtype: float64
```

```
plt.tricontourf(X['Easting'],X['Northing'],residual,15)
cbar = plt.colorbar()
cbar.set_label('Residual Gravity (mGal)')
plt.scatter(X['Easting'],X['Northing'],1,'black')
plt.xlabel('Easting (m)')
plt.ylabel('Northing (m)')
plt.title('Countour Plot of residual Data')
```

```
Text(0.5, 1.0, 'Countour Plot of residual Data')
```



But really not sure if this is what the question is being asked but my answer from the understanding I something like , we've been studying snails and the holes they drill in clams in part 1. We used a method called linear regression to figure out how the size of a snail relates to the holes it makes. Now, let's say we come across a really big snail, one we didn't study before. By using what we've learned from the other snails, we can predict how big the holes would be if this snail drilled them. These predictions help us guess the size of the predator that might have eaten the clam. If the holes are big, it could mean a bigger predator, and if they're smaller, maybe a smaller one. It's like connecting the dots between snail size, hole size, and predator size based on what we've seen. But also another method from my understading can be used is the non-linear regression method that is if we find a really big snail that wasn't part of our initial study we can think about non-linear connections between snail size and the holes it makes. Unlike the simple straight lines of linear regression, non-linear regression fits more flexible curves to our data points. This is handy when we want to predict hole sizes made by an unusually large snail and needed more flexibility which can be used in real life analysis.