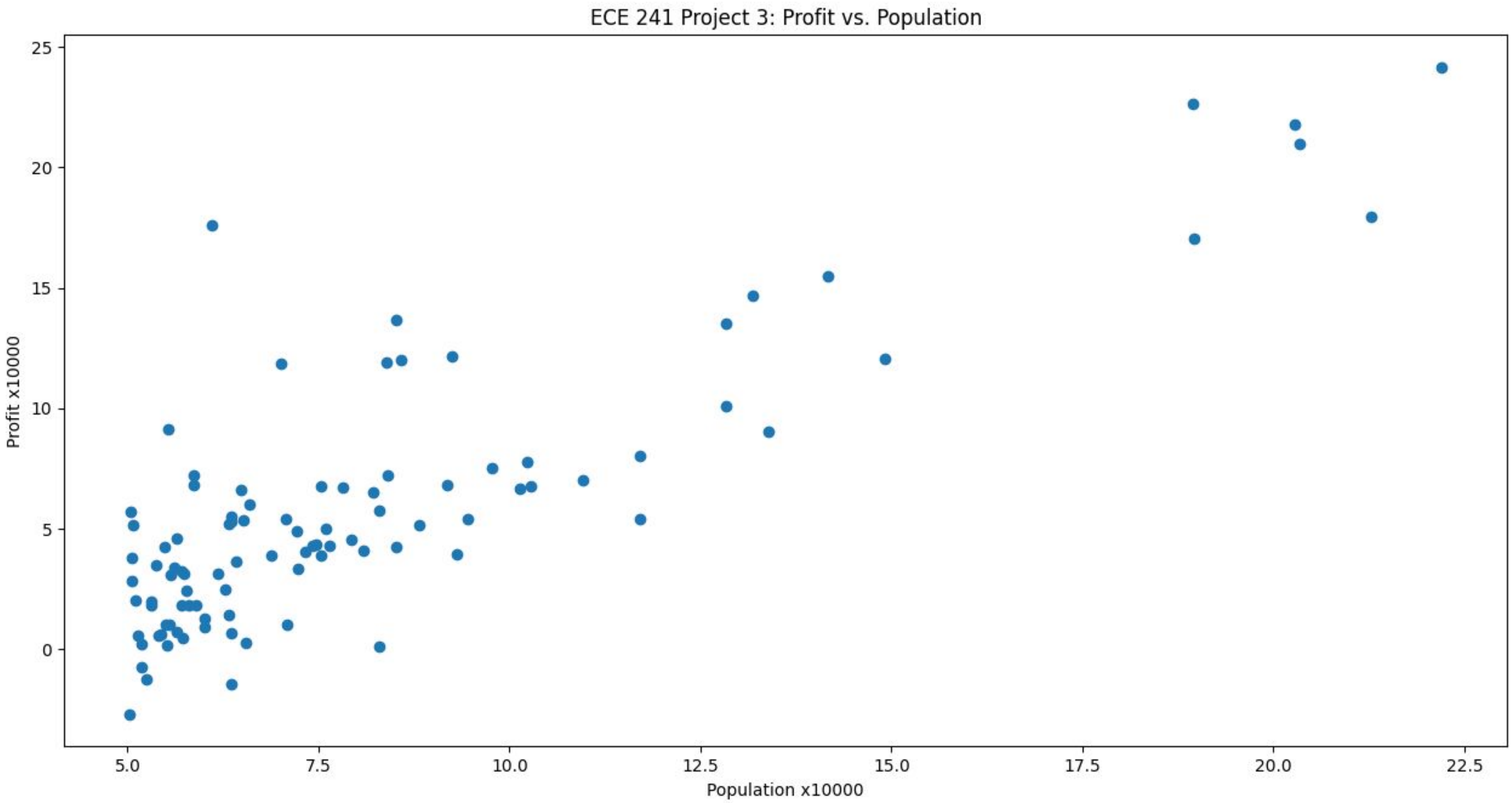
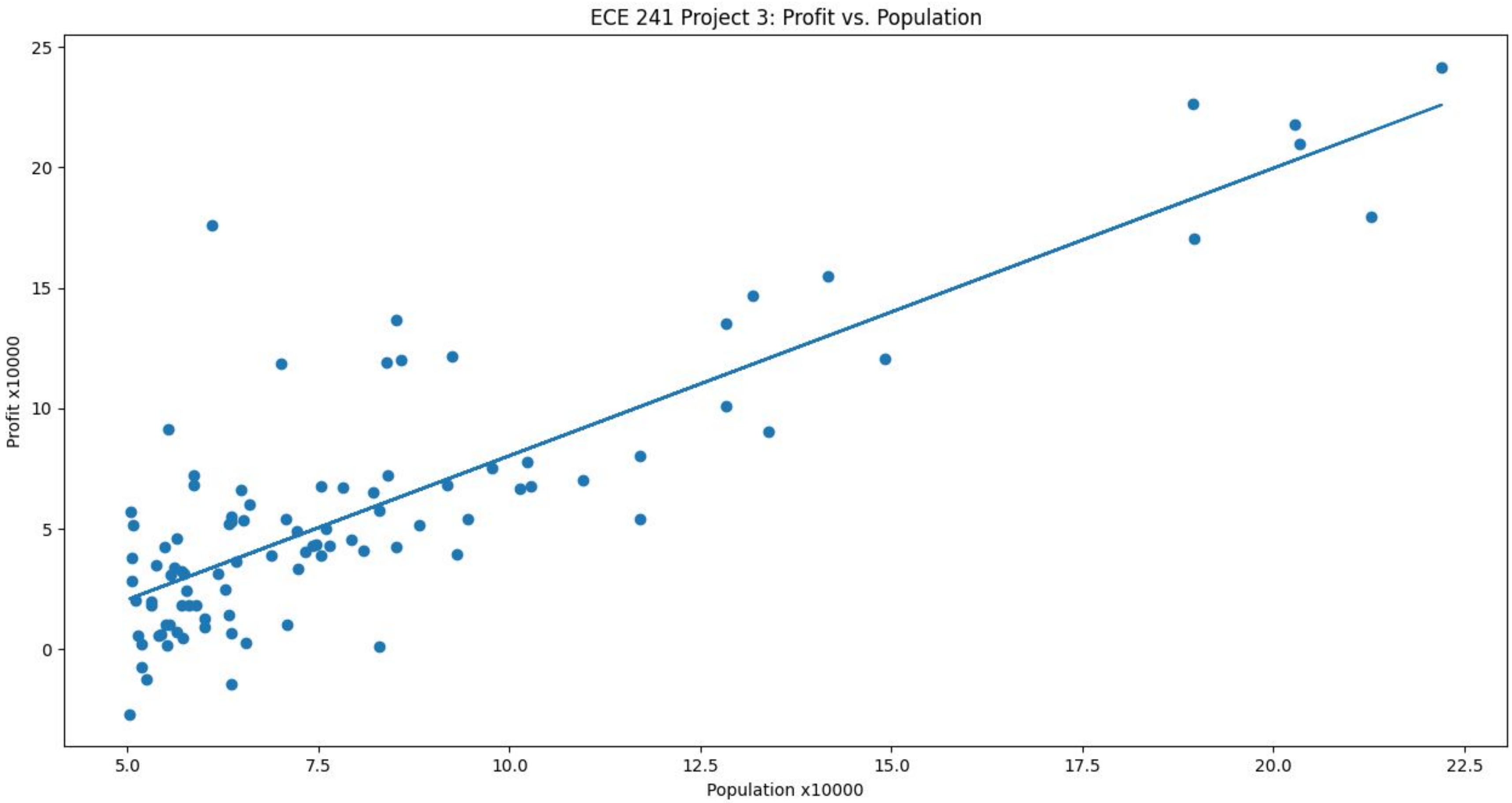

ECE 241 Project 3: Profit vs. Population
Profit x10000
Population x10000
25
20
15
10
5
0
5.0
7.5
10.0
12.5
15.0
17.5
20.0
22.5

```
# ------ Problem 1(b) ------

model = LinearRegression().fit(population.reshape((-1, 1)), profit)
b = model.intercept_  # creates variable of the intercept of the line of best fit
m = model.coef_  # creates variable for the slope for the line of best fit
y_pred = model.intercept_ + model.coef_ * x  # creates new array with line of best fit values
```


ECE 241 Project 3: Profit vs. Population
Profit x10000
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22.5

```python
# ------ Problem 1(e) ------

values = np.array([7.8, 4.4, 4.7, 6.12, 8.55, 6.7, 9.8, 7.01]).reshape((-1,1))  # numpy array of pop values
prof_pred = model.predict(values)  # predicts profits for these pop values
print(prof_pred)
```

City	Population	Estimated Revenue ($)
G	9.8 x 10000	7.79594883 x 10000
E	8.55 x 10000	6.30465678 x 10000
A	7.8 x 10000	5.40988155 x 10000
H	7.01 x 10000	4.46738497 x 10000
F	6.7 x 10000	4.09754454 x 10000
D	6.12 x 10000	3.40558502 x 10000
C	4.7 x 10000	1.71147725 x 10000
B	4.4 x 10000	1.35356716 x 10000

```
# ------ Problem 1(f) ------

prediction = model.predict(population.reshape((-1,1)))
print(mean_absolute_error(profit, y_pred))
```

241_Project3_Code

```
C:\Users\owner\Downloads\ECE241_Project3\venv\Scripts\python.exe C:/Users/owner/Downloads/ECE241_Project3/241_Project3_Code.py
2.1942453988270065

Process finished with exit code 0
```

Project 3 Problem 2

Saturday, December 5, 2020 12:19 PM

A

$$\frac{d\,f(x)}{dB} = \sum_1^m 2 \cdot wx_i + B - y_i$$

$$\frac{d\,f(x)}{dB} = 2\sum_1^m w \cdot x_i + B - y_i$$

$$\frac{d\,f(x)}{dw} = \sum_1^m 2 \cdot [wx_i + B - y_i] \cdot x_i$$

$$\frac{d\,f(x)}{dw} = 2 \cdot \sum_1^m x_i \cdot [wx_i + B - y_i]$$

$$\frac{d\,f(x)}{dB} = 0 = 2\sum_1^m w \cdot x_i + B - y_i$$

$$0 = \sum_1^m w \cdot x_i + B - y_i$$

$$0 = \sum_1^m w \cdot x_i + \sum_1^m B - \sum_1^m y_i$$

$$0 = \sum_1^m w \cdot x_i + Bm - \sum_1^m y_i$$

$$Bm = \sum_1^m y_i - \sum_1^m w \cdot x_i$$

$$\boxed{B = \overline{y_i} - w\overline{x_i}}$$

$$0 = 2 \cdot \sum_1^m x_i [wx_i + B - y_i]$$

$$0 = \sum_1^m x_i [wx_i + B - y_i]$$

$$0 = \sum_1^m wx_i^2 + \sum_1^m Bx_i - \sum_1^m x_i y_i$$

$$0 = w\sum_1^m x_i^2 + B\sum_1^m x_i - \sum_1^m x_i y_i$$

$$w \cdot \sum_1^m x_i^2 = \sum_1^m x_i y_i - B\sum_1^m x_i$$

$$w = \frac{\sum_1^m x_i y_i - B\sum_1^m x_i}{\sum_1^m x_i^2}$$

$$w = \frac{\sum_1^m x_i y_i - [\overline{y_i} - w\overline{x_i}] \cdot \sum_1^m x_i}{\sum_1^m x_i^2}$$

$$w = \frac{\sum_1^m x_i y_i - \overline{y_i} \cdot \sum_1^m x_i + w\overline{x_i}\sum_1^m x_i}{\sum_1^m x_i^2}$$

$$w - \frac{w\overline{x_i}\sum_1^m x_i}{\sum_1^m x_i^2} = \frac{\sum_1^m x_i y_i - \overline{y_i}\sum_1^m x_i}{\sum_1^m x_i^2}$$

$$w\left[1 - \frac{\overline{x_i}\sum_1^m x_i}{\sum_1^m x_i^2}\right] = \frac{\sum_1^m x_i y_i - \overline{y_i}\sum_1^m x_i}{\sum_1^m x_i^2}$$

$$w = \frac{\dfrac{\sum_1^m x_i y_i - \overline{y_i}\sum_1^m x_i}{\sum_1^m x_i^2}}{\dfrac{\sum_1^m x_i^2 - \overline{x_i}\sum_1^m x_i}{\sum_1^m x_i^2}}$$

$$w = \frac{\sum_1^m x_i y_i - \overline{y_i}\sum_1^m x_i}{\sum_1^m x_i^2 - \overline{x_i}\sum_1^m x_i}$$

$$\boxed{w = \frac{\sum_1^m (x_i - \bar{x})(y_i - \bar{y})}{\sum_1^m (x_i - \bar{x})^2}}$$

$$\boxed{B = \overline{y_i} - \overline{x_i}\left[\frac{\sum_1^m (x_i - \bar{x})(y_i - \bar{y})}{\sum_1^m (x_i - \bar{x})^2}\right]}$$

B

$$var = \frac{\sum (x_i - \mu_x)^2}{N-1}$$

$$COV = \frac{\sum (x_i - \mu_x)(y_i - \mu_y)}{N-1}$$

$$\mu_x = \frac{\sum x_i}{m} = \overline{x_i}$$

$$\mu_y = \frac{\sum y_i}{m} = \overline{y_i}$$

$$w = \frac{\sum_1^m (x_i - \bar{x})(y_i - \bar{y})}{\sum_1^m (x_i - \bar{x})^2} = \frac{\sum_1^m (x_i - \bar{x})(y_i - \bar{y})}{\sum_1^m (x_i - \bar{x})^2} \cdot \frac{\left[\frac{1}{(N-1)}\right]}{\left[\frac{1}{(N-1)}\right]} = \frac{\frac{\sum (x_i - \bar{x})(y_i - \bar{y})}{N-1}}{\frac{\sum (x_i - \bar{x})^2}{N-1}} = \boxed{\frac{COV}{VAR}}$$

$$B = \overline{y_i} - w\,\overline{x_i} = \boxed{\overline{y_i} - \overline{x_i} \cdot \frac{COV}{VAR}}$$