Fitting a Linear Regression Model on UW Dining Data (July - Aug 2025)

We pick a mathematical model to fit data

Let's pick a linear model:

$$B(t) = \theta_0 + \theta_1 t_1$$

θ_0 - intercept

θ_0 - slope

formulate least squares problem

data set: $\{t_i, b_i\}_{i=1}^{m}$ $\quad m = 56$

(t_i: dates, b_i: balance)

$$\underset{\underline{\theta} \in \mathbb{R}^2}{\text{minimize}} \ \frac{1}{2} \sum_{i=1}^{m} \left| \theta_0 + \theta_1 t_i - b_i \right|^2$$

Observe: $\theta_0 + \theta_1 t_i = \begin{bmatrix} 1 & t_i \end{bmatrix} \begin{bmatrix} \theta_0 \\ \theta_1 \end{bmatrix}$

so $A = \begin{bmatrix} 1 & t_1 \\ 1 & t_2 \\ \vdots & \vdots \\ 1 & t_m \end{bmatrix} \in \mathbb{R}^{m \times 2}$

Then $\underset{\underline{\theta}}{\text{minimize}} \ \frac{1}{2} \| A\underline{\theta} - \underline{b} \|_2^2$

Coding it to Python

$\theta_0 \approx 1146.41330864$

$\theta_0 \approx 1146.42330864$

$\theta_1 \approx -20.06482551$

Fitted Linear model is $B(t) \approx 1146 - 20t$

Interpreting Parameters

If I plug in a no. of days t since July 5, 2025, I get a balance in $.

θ_0: balance on the first date in data

θ_1: change in balance per day (decreases by ≈ $20 per day)

Problem

Want to determine whether my dining balance hits 0 before quarter ends.

Want $B(t) = 0 = \theta_0 + \theta_1 t$ so solve for t

$\theta_1 t = -\theta_0$

$t = \frac{-\theta_0}{\theta_1}$

In code,

Balance will reach 0 after around 57 days from July 5, 2025 so August 26, 2025

```
# When will the balance reach zero?
t_zero = -theta[0] / theta[1]
t_zero
```

0.0s

```
np.float64(57.135971999101095)
```

SUMMER 2025

Full-term	A

I need to spend more since quarter ends Aug 22, 2025.

SUMMER 2025

Full-term	A
Jun 23, 2025	Ju
Aug 22, 2025	Ju