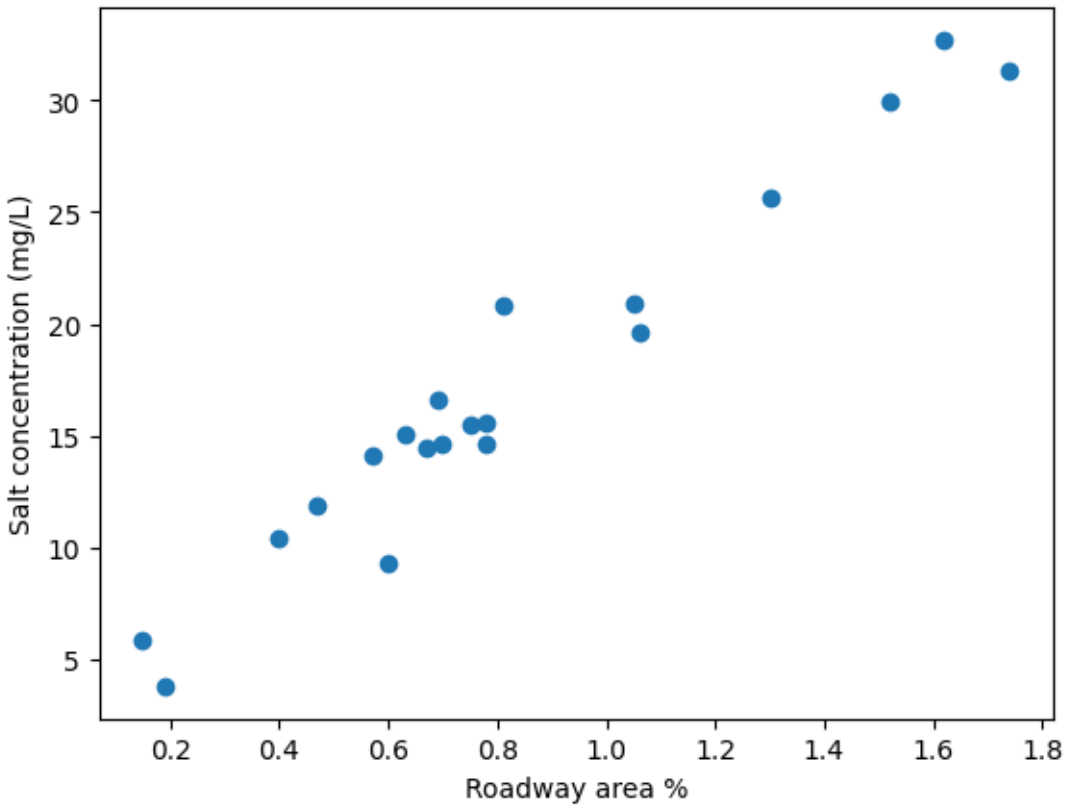
LinearModels2

February 2, 2023

1 Least Square Regression

[8]:
```
import matplotlib.pyplot as plt
# Plot the points
fig, ax = plt.subplots()
# Scatter plot using matplotlib
def plot_salt_scatter(ax, salt_concentration_data):
    ax.scatter(salt_concentration_data[:, 2], salt_concentration_data[:, 1])
    ax.set_xlabel(r"Roadway area %")
    ax.set_ylabel(r"Salt concentration (mg/L)")
plot_salt_scatter(ax, salt_concentration_data)
```



1.1 Vectorized least square

1.2 Matrix-vector product

1.3 Least square using matrices

1.4 Dot product as matrix product

1.5 Matrix transpose properties

1. $(A + B)^\top =?$
2. $(AB)^\top =?$

1.6 In-class exercise

Expand

$$(\mathbf{y} - \mathbf{Xm})^\top (\mathbf{y} - \mathbf{Xm})$$

1.7 Quadratic form

1. Single variable
2. Two variable
3. n-variable vectorized

1.8 Vector derivatives

1.9 In-class exercises

1. Find the derivative of $\mathbf{x}^\top \mathbf{A}\mathbf{x}$ with respect to $\mathbf{x}$.
2. Find the derivative of $\mathbf{b}^\top \mathbf{x}$ with respect to $\mathbf{x}$.

1.10 Back to least square regression

Minimizing any quadratic function of n-variables.

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1.11 Code in numpy