Introduction to Linear Regression

- **Linear regression** is a method used to model the relationship between a dependent variable and one or more independent variables.
- It assumes that there is a linear relationship between the variables and tries to find the line of best fit that minimizes the sum of squared errors.


Linear regression summary

Simple Linear Regression

- Simple linear regression involves modeling the relationship between a dependent variable `y` and a single independent variable `x`.
- The line of best fit can be represented by the equation `y = b0 + b1*x`, where `b0` is the y-intercept and `b1` is the slope of the line.

- Multiple linear regression involves modeling the relationship between a dependent variable `y` and multiple independent variables `x1, x2, ..., xn`.
- The line of best fit can be represented by the equation `y = b0 + b1*x1 + b2*x2 + ... + bn*xn`.

$$\frac{1}{E^*} = \frac{1-\nu_1^2}{E_1} + \frac{1-\nu_2^2}{E_2}$$

$$a = \sqrt[3]{\frac{3WR_e}{4E^*}}$$

$$m^2 = \frac{1}{2}\left[\left\{\left(a^2 - x^2 + z^2\right)^2 + 4x^2z^2\right\}^{1/2} + \left(a^2 - x^2 + z^2\right)\right]$$

$$n^2 = \frac{1}{2}\left[\left\{\left(a^2 - x^2 + z^2\right)^2 + 4x^2z^2\right\}^{1/2} - \left(a^2 - x^2 + z^2\right)\right]$$

$$\sigma_x = -\frac{p_0}{a}\left\{m\left(1 + \frac{z^2 + n^2}{m^2 + n^2}\right) - 2z\right\}$$

$$\sigma_z = -\frac{p_0}{a}m\left(1 - \frac{z^2 + n^2}{m^2 + n^2}\right)$$

in Python

- We can use the `LinearRegression` class from the `scikit-learn` library to perform linear regression in Python.
- Here is an example of how to fit a simple linear regression model:

```
from sklearn.linear_model import LinearRegression

# define the data
X = [[0], [1], [2]]
y = [0, 1, 2]

# create and fit the model
model = LinearRegression()
model.fit(X, y)
```

- We can use visualization libraries such as matplotlib or seaborn to create scatter plots and visualize the line of best fit.
- Here is an example of how to create a scatter plot with a fitted line:

```
import matplotlib.pyplot as plt

# define the data
X = [0, 1, 2]
y = [0, 1, 2]

# plot the data
plt.scatter(X, y)

# plot the fitted line
plt.plot(X, y)
```