① Root finding / Zero finding

$$\sqrt{2} \rightarrow f(x) = x^2 - 2 = 0$$
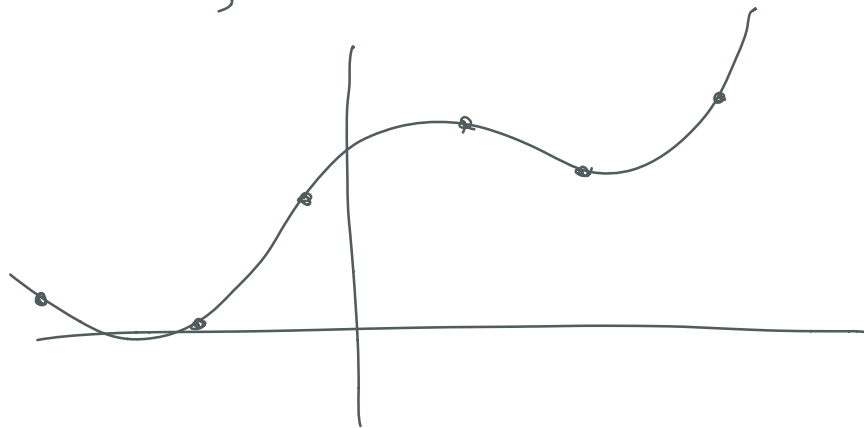
~~Taylor~~ Expansion

✓. Bisection Method   Pros/Cons

✓. Newton-Raphson Method Pros/Cons

✓. Secant Method   Pros/Cons

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② Curve Fitting

Loss function

$$\boxed{a_0} + \boxed{a_1} x + \boxed{a_2} x^2 + \boxed{a_3} x^3$$

$$\sum_i \left[\left(y_i - \left(a_0 + a_1 x_i + a_2 x_i^2 + a_3 x_i^3 \right) \right) \right]$$

- Grid Search
- Fminsearch (Simplex Method)
-
-

(3) Optimization

- Grid Search
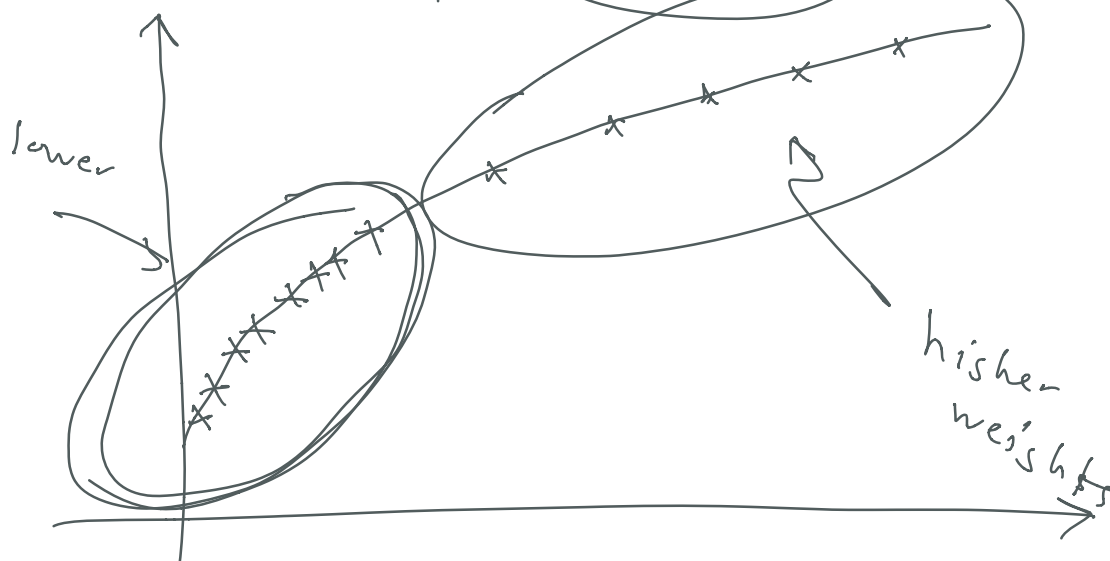- Fminsearch
- Gradient Descent
    - Vanilla
    - MiniBatch
    - Stochastic

Objective/Loss Function

$\left(x_i, y_i \right)$ $\left(x_i, \hat{y}_i \right)$

$$\sum_{i=1}^{n} \left\| y_i - \hat{y}_i \right\|$$

lower

higher weights

4/9/18

4/9/23

20%

$1000

$2000

5 yr

zero-coupon

$1100

$100

Bond Trading

$$\sum_{i=1}^{n} w_i \left\| y_i - \hat{y}_i \right\|$$

xo

$i-1$

subjective

1 $\textcircled{1}$ for closer points

$\textcircled{10}$ $\textcircled{2}$ for points ~~at~~ close to maturity

$$\boxed{\text{Weighted obj function}}$$

$$\boxed{\text{Optimization}}$$

Curve Fitting   Over fitting

✓ $\boxed{a_0}$

✓ $\boxed{a_0 + a_1 x}$

✓ $\boxed{a_0 + a_1 x + a_2 x^2}$

$\vdots$

$$\sum_{i=0}^{n} a_i x^i$$

maturity

arb.

quadrat" MF

MM

exp

Cont.
slope.

Gradient-Free