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1. MSE

$$MSE = \sum_{i=1}^{n} (y_i - a)^2$$

$$= \sum_{i=1}^{n} y_i^2 - \sum_{i=1}^{n} 2ay_i + \sum_{i=1}^{n} a^2$$

differentiate w.r.t a

$$MSE' = -2\sum_{i=1}^{n} y_i + 2\sum_{i=1}^{n} a$$

$$= -2\sum_{i=1}^{n} y_i + 2na$$

MSE'' w.r.t. a (check convex or concave)

$= 2n$, which > 0, it is convex

then when $MSE' = 0$, MSE will be minimized.

that is $-2\sum_{i=1}^{n} y_i + 2na = 0$, $a = \frac{2\sum_{i=1}^{n} y_i}{2n}$, which is average #

2. MAE

$MAE = \sum_{i=1}^{n} |actual_i - predicted_i|$

we want to minimize errors, we get $\min E[|X-c|]$

$$E[|X-C|] = -0.5\int_{-\infty}^{c} (x-c) f(x)\,dx + 0.5\int_{c}^{\infty} (x-c) f(x)\,dx$$

differentiate

* f(x) is probability density function.

We seperate it into two part.

(1) $f(x)\cdot(c-c)\frac{dc}{dc} + \int_{-\infty}^{c} \frac{\partial}{\partial c}[f(x)(c-x)]\,dx = \int_{-\infty}^{c} p(x)\,dx$

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$(2): -f(x)(C-C)\frac{dC}{dC} + \int_{C}^{\infty}[f(x)(x-C)]\,dx = -\int_{C}^{\infty} p(x)\,dx$

because $MAE' = \int_{-\infty}^{C} p(x)\,dx - \int_{C}^{\infty} p(x)\,dx = 0$

$\therefore \int_{-\infty}^{C} f(x)\,dx = \int_{C}^{\infty} f(x)\,dx.$

and from this function,

we can write P.D.F $P(x \le C) = P(x \ge C)$

Given $P(x \le C) + P(x \ge c) = 1$

$\Rightarrow P(x \le c) = P(x \ge c) = \frac{1}{2}$, the position goes to

50%, median will minimize MAE #

MSPE and MAPE, we can subtract the denominator

and apply the result from MSE and MAE,

which will respectly minimize by Average and Median.
(MSPE & MAPE)