TRUE FUNCTION: $y = x$

x	y
1	1
2	2

TRUE FUNCTION: $y = 100 + x$

x	y
1	101
2	102

TRUE FUNCTION: $y = x$

x_0	x	y
1	1	1
1	2	2

ADD COLUMN OF 1's

TRUE FUNCTION: $y = 100 + x$

x_0	x	y
1	1	101
1	2	102

TRUE FUNCTION: $y = x$

x_0	x	y
1	1	1
1	2	2

CASE 1: $I = I_{2\times 2}$

$\mu = 100$

TRUE FUNCTION: $y = 100 + x$

x_0	x	y
1	1	101
1	2	102

TRUE FUNCTION: $y = x$

x_0	x	y
1	1	1
1	2	2

CASE 1: $I = I_{2\times 2}$

$\mu = 100$

$$\hat{\theta} = (X^T X + \mu I)^{-1} X^T y$$

$$\hat{\theta} = [0.02 \quad 0.046]^T$$

TRUE FUNCTION: $y = 100 + x$

x_0	x	y
1	1	101
1	2	102

TRUE FUNCTION: $y = x$

x_0	x	y
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$$\hat{\theta} = [0.02 \quad 0.046]^T$$

TRUE FUNCTION: $y = 100 + x$

x_0	x	y
1	1	101
1	2	102

$$\hat{\theta} = [1.9 \quad 2.8]^T$$

TRUE FUNCTION: $y = x$

x_0	x	y
1	1	1
1	2	2

CASE I: $I = I_{2\times 2}$

$\mu = 100$

$$\hat{\theta} = (X^T X + \mu I)^{-1} X^T y$$

$$\hat{\theta} = [0.02 \quad 0.046]^T$$

$$\hat{y}(0) = 0.02$$

TRUE FUNCTION: $y = 100 + x$

x_0	x	y
1	1	101
1	2	102

$$\hat{\theta} = [1.9 \quad 2.8]^T$$

$$\hat{y}(0) = 1.9$$

TRUE FUNCTION: $y = x$

x_0	x	y
1	1	1
1	2	2

CASE 2: USE I^*, $\mu = 100$

$$\hat{\theta} = (X^T X + \mu I^*)^{-1} X^T y$$

$$\hat{\theta} = [1.49 \quad , 0.0049]^T$$

$$\hat{y}(0) = 1.49$$

TRUE FUNCTION: $y = 100 + x$

x_0	x	y
1	1	101
1	2	102

$$\hat{\theta} = [101 \, , \sim 0]^T$$

$$\hat{y}(0) = 101$$

TRUE FUNCTION: $y = x$

x_0	x	y
1	1	1
1	2	2

CASE 2 : USE I^*
$\mu = 100$

$$\hat{\theta} = (X^T X + \mu I^*)^{-1} X^T y$$

$$\hat{\theta} = [1.49 \quad , 0.0049]^T$$

$$\hat{y}(0) = 1.49$$

$\Rightarrow$ TENDS TOWARDS $\bar{y}$

TRUE FUNCTION: $y = 100 + x$

x_0	x	y
1	1	101
1	2	102

$$\hat{\theta} = [101 \quad , \sim 0]^T$$

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TENDS TOWARDS $\bar{y}$

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$\Rightarrow$ TENDS TOWARDS $\bar{y}$

TRUE FUNCTION: $y = 100 + x$

x_0	x	y
1	1	101
1	2	102

$$\hat{\theta} = [101 \quad , \sim 0]^T$$

$$\hat{y}(0) = 101$$

TENDS TOWARDS $\bar{y}$

ALTERNATIVE APPROACH

① TRANSFORM $y \rightarrow y'$ s.t. $\bar{y}' = 0$

$$y' = y - \bar{y}$$

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NO NEED TO USE I^* HERE

TRUE FUNCTION: $y = 100 + x$

x_0	x	y
1	1	101
1	2	102

$\bar{y} = 101.5$

TRUE FUNCTION: $y = 100 + x$

x_0	x	y	y'
1	1	101	-0.5
1	2	102	0.5

TRUE FUNCTION: $y = 100 + x$

x_0	x	y	y'
1	1	101	-0.5
1	2	102	0.5

$$\hat{\theta} = (X^T X + \mu I)^{-1} X^T y'$$

$$= [-0.0001, \quad 0.0047]^T$$

TRUE FUNCTION: $y = 100 + x$

x_0	x	y	y'
1	1	101	-0.5
1	2	102	0.5

$$\hat{\theta} = (X^T X + \mu I)^{-1} X^T y'$$

$$= [-0.0001, \quad 0.0047]^T$$

$$\hat{y}'(0) = 0$$

$$\hat{y}(0) = \hat{y}'(0) + \bar{y} = 101.5$$