Question 2: Gradient Descent Algorithm (By hand)

In case you want to take a picture (screenshot) of your notebook (tablet), you can use the below lines to embed the image to the output PDF file:

```
knitr::include_graphics('question2.jpg')
```

Question 2

After Iteration 1

House Price, Y	land size, X	Predicted House price, $\hat{Y}$	Predicted House Price, $\hat{y}$	Predicted House Price, $\hat{y}$
100	1	10	90.1	92.5
200	2.5	20	225.25	231.25
300	3	30	270.3	277.5
		if $\phi_j = 0.1$	if $\phi_{j+1} = 90.1$	

Model equation

H-House price (landsize) = $\phi_0 + \phi_i \text{landsize}_i + \varepsilon_i$

$\phi_j = 0.1$, $\alpha = 0.1$ → choose random.

Linee equation for best fit → $\bar{y} = \phi_j x_i$

$J(\phi)$: Loss = RMSE = $\frac{1}{N}\sum_{1}^{3}(\hat{y}_i - \hat{y}_i)^2$ = 20.5200

$\frac{\partial L}{\partial \phi_j} = -\frac{2}{3}\sum(\hat{y}_i - \hat{y}_i)x_i$

Iteration 1

$\frac{\partial L}{\partial \phi_j} = -\frac{2}{3}[(100-10) + (200-20)(2.5) + (300-30)(3)]$

$\frac{\partial L}{\partial \phi_j} = -900$

$\phi_{j+1} = \phi_j - \alpha\frac{\partial L}{\partial \phi_j}$

$= 0.1 - (0.1)(-900)$

$= 0.1 + 90$

$= 90.1$ //

Loss update = $\frac{2}{3}\sum(y_i - \hat{y}_i)x_i$

= 2892 ✓ smaller loss!

Iteration 2

$\frac{\partial L}{\partial \phi_{j+1}} = -\frac{2}{3}[(100-90.1) + (2.5)(200-225.25) + (3)(300-270.3)]$

$= -23.98$

$\phi_{j+2} = \phi_{j+1} - \alpha\frac{\partial L}{\partial \phi_{j+1}}$

$= 90.1 - (0.1)(-23.98)$

$= 90.1 + 2.398$

$= 92.498 \approx 92.5$

random $\phi_j = 0.1$

Iter 1 $\phi_{j+1} = 90.1$

Iter 2 $\phi_{j+2} = 92.5$ //