Let us first find the MSE of $\widehat{\mu}_{MSE}$ by simulation:

```
n = 10;
a = 1;
B = 3;
m = 10^4;
mu = (a + B)/2;
sum = 0;
for i = 1:m
    X = a + (B-a) * rand(n,1);
    sum = sum + (((min(X) + max(X))/2) - mu)^2;
end
MSE_sim = sum/m;
disp("MSE of MLE of mu"); disp(MSE_sim);
```

```
MSE of MLE of mu
    0.0152
```

Let us now find the MSE of the plug-in estimate $\widehat{\mu}_n = \overline{X}_n$ of μ analytically:

We know $MSE[\widehat{\mu}_n] = bias[\widehat{\mu}_n]^2 + se[\widehat{\mu}_n]^2$:

$$\rightarrow bias[\widehat{\mu}_n] = \mathbb{E}[\widehat{\mu}_n] - \mu = \mu - \mu = 0$$

$$\rightarrow se[\widehat{\mu}_n] = \frac{\sigma}{\sqrt{n}} = \frac{1}{\sqrt{n}} \cdot \sqrt{\frac{(\beta-\alpha)^2}{12}} = \frac{1}{\sqrt{10}} \cdot \sqrt{\frac{(3-1)^2}{12}} = \frac{2}{\sqrt{120}} \qquad \text{(ignore sampling fraction)}$$

$$\rightarrow MSE[\widehat{\mu}_n] = 0^2 + (\frac{2}{\sqrt{120}})^2 = \frac{1}{30} \approx 0.0333$$

Therefore, we see that the MSE of $\widehat{\mu}_n$ is about 2 times greater than the simulated MSE of $\widehat{\mu}_{MSE}$.