Book Problems Chp 2: 1(a-c), 2, 5, 7, 8, 9

Remark: Students enrolled in STAT 4463 need not work the challenge problems on homework assignments labeled "Grad Students only".

Remark 2: Don't forget to write in complete sentences and always justify your answers.

Setup: Generate data as below and consider estimating f as one of the following functions

$$f_1(X) = \beta_0 + \beta_1 X$$

$$f_2(X) = \beta_0 + \beta_1 X + \beta_2 X^2 + \beta_3 X^3$$

---------------------------------- Code ----------------------------------
```
set.seed(1)
x<- seq(from = -2, to = 2, by=.1)
y<- 100 + 2*x - x^2 + rnorm(41)
```

1. What is $f(x)$, $\hat{f}_1(x)$ and $\hat{f}_2(x)$ for this data? Use lm() to get estimates.

2. Construct a plot with the true $f(x)$ and estimates of $f_1(x)$ and $f_2(x)$ superimposed. Each line should be a different color and type.

3. Compute $f(0)$ and $\hat{f}_1(0)$ and identify them on your plot. Is the difference between these values reducible or irreducible error? Explain why in a sentence or two.

4. Compute $f(0)$ and $\hat{f}_2(0)$ and identify them on your plot. Is the difference between these values reducible or irreducible error? Explain why in a sentence or two.

5. Get y_{21} and $f(0)$ and identify them on your plot. Is the difference between these values reducible or irreducible error? Explain why in a sentence or two.

6. Suppose you have test data $(x, y) = (-1, 94), (0, 100), (1, 100)$. Get the test MSE for both functions based on this test data.

7. (Grad Student only) Regenerate data above but change set.seed(1) to set.seed(2). Compare $\hat{f}_1(0)$ and $\hat{f}_2(0)$ for this data to your previous answers for $\hat{f}_1(0)$ and $\hat{f}_2(0)$. Is this difference attributable to the bias or variance of your predictions?

8. (Grad Students only) Provide an estimate for the bias of $\hat{f}_2(0)$ using your two $\hat{f}_2(0)$ answers and $f(0)$.

9. Will $\hat{f}_1$ or $\hat{f}_2$ generally have smaller variance?

10. Will $\hat{f}_1$ or $\hat{f}_2$ generally have the smallest (amount of) bias?

11. Explain, in a sentence or two, whether you should choose f_1 or f_2 to minimize the mean squared test error when n is "large". Your answer must include terms "Bias" and "Variance".