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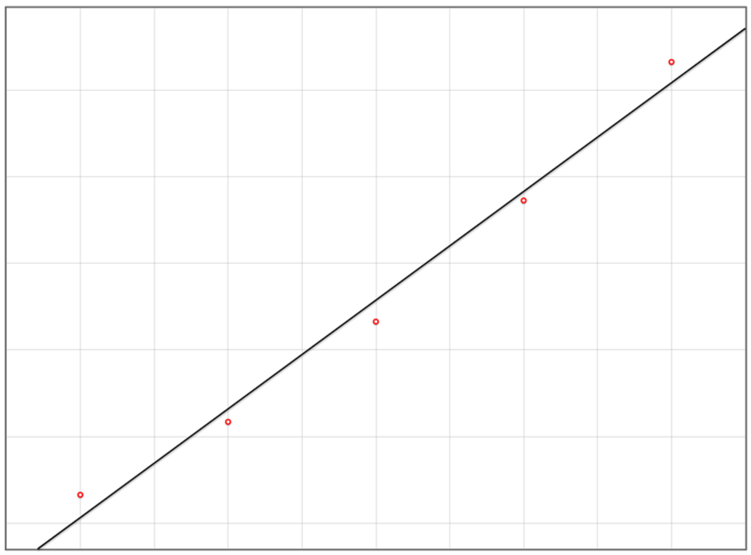
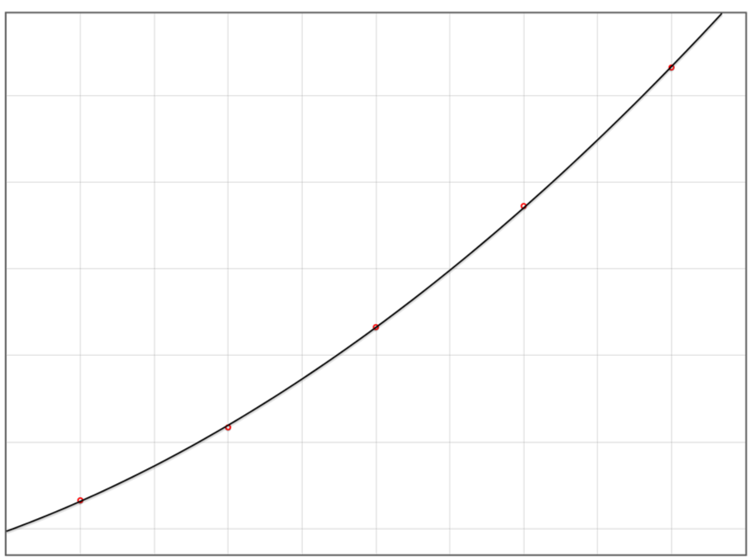
CSE 3521

Homework #9

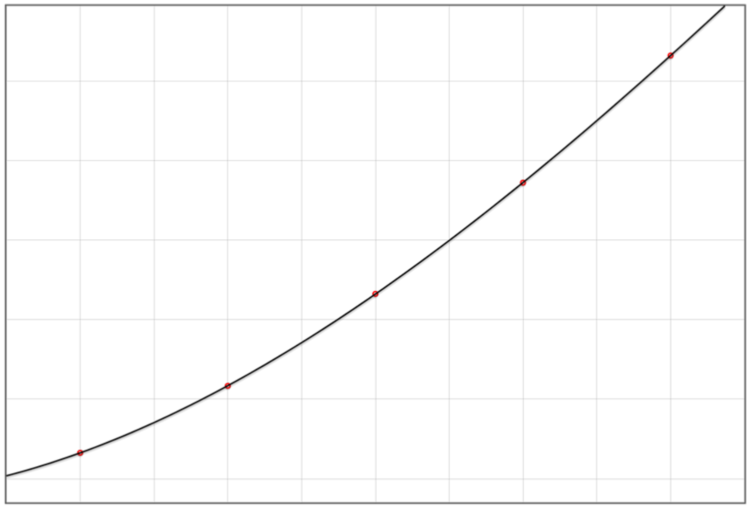
1.
   a. $SSE(y = ax + b) = 0.22131790000000018$

   b. 

2.
   a. $SSE(ax^2 + bx + c) = 0.0013161142857142745$

   b. 

   c. $SSE(ax^3 + bx^2 + cx + d) = 0.000016514285714284396$

d. 

e. $SSE(ax^4 + bx^3 + cx^2 + dx + e) = 4.954960433513401e - 20$

f. 

g. We think the last model best fits the data, since the value of SSE measures the discrepancy between the data and an estimation model. Hence, when we should choose the model has the smallest SSE value.

3.

a. $\frac{d}{da}f(x) = x^b$

b. $\frac{d}{db}f(x) = ax^b \log \quad x$

c. $\frac{d}{dc}f(x) = x$

d. $\frac{d}{dd}f(x) = 1$

4.

a. Iteration 0: SSE=86.91664599999999

b. Iteration 1: SSE=1.2257484260435025

c. Iteration 2: SSE=0.002951589411860112

d. Iteration 3: SSE=0.045031842180812805

e. Iteration 4: SSE=0.000004780982168256427

f. Iteration 5: SSE=2.209080239166643e-7

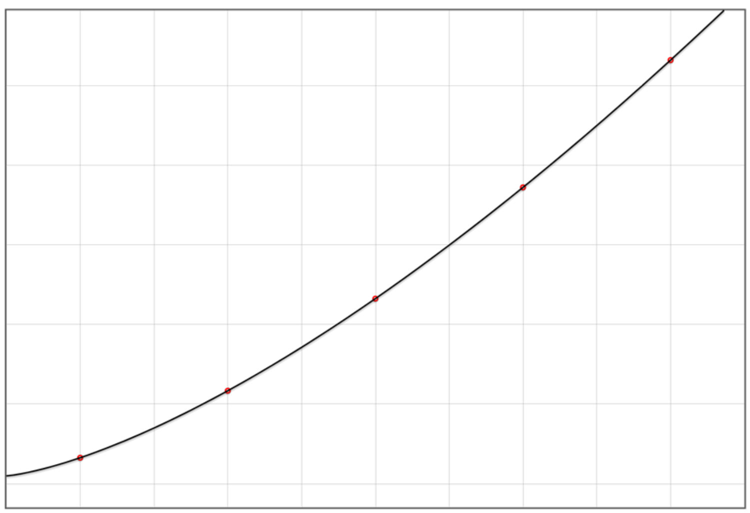
g. Iteration 6: SSE=2.2090783285717636e-7

h. Iteration 7: SSE=2.2090783285710132e-7

i. Iteration 8: SSE=2.2090783285686171e-7

j. Iteration 9: SSE=2.2090783285678834e-7

k. Iteration 10: SSE=2.2090783285663804e-7

l. 

m. We do think this model fits the data better than previous one. After 10 iteration, the Gauss-Newton method is providing a smaller number compare to Polynomial ($SSE = 1.65143 * 10^{-5}$). The Gauss-Newton method's performance depends on the iteration times. Hence, when we are utilizing Gauss-Newton method, we need to make sure to there are enough iterations.

5.

a. Iteration 0: SSE=86.91664599999999

b. Iteration 1: SSE=9.823254279495549

c. Iteration 2: SSE=1.9886924028316724

d. Iteration 3: SSE=0.6616441968742724

e. Iteration 4: SSE=0.4614402093746779

f. Iteration 5: SSE=0.4304949859231547

g. ...

h. Iteration 4995: SSE=0.00020930544167242234

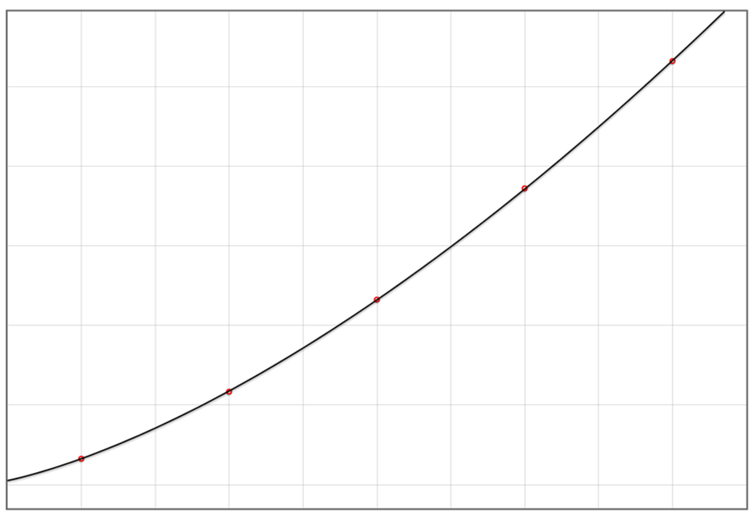
i. Iteration 4996: SSE=0.00020925042055905206

j. Iteration 4997: SSE=0.00020919546901500068

k. Iteration 4998: SSE=0.00020914058694998782

l. Iteration 4999: SSE=0.00020908577427385791

m. Iteration 5000: SSE=0.0002090310308965403

n. 

o. The algorithm did not beat the Gauss-Newton method.

p. When we are using 0.0015 as our learning rate, we will have $SSE = 0.00011184159014531948$ after 5000 iteration, which is a better convergence rate.

q. When we increase or decrease the learning rate dramatically, the fitness of the curve is worse than before.

r. Compare to default value, when we increase the iterations, the fitness of the curve is improved. Oppositely, when we decrease the iterations, the fitness of the curve is degraded.