Homework 12

The **due date** for this homework is **Tue 7 May 2013 12:00 AM EDT**.

Question 1

Use a linear approximation to estimate $\sqrt[3]{67}$. Round you answer to four decimal places.

Hint: remember that $\sqrt[3]{64} = 4$. You can check the accuracy of this approximation by noting that $\sqrt[3]{67} \approx 4.0615$.

Question 2

Use a linear approximation to estimate the cosine of an angle of 66°. Round you answer to four decimal places.

Hint: remember that $60^{\circ} = \frac{\pi}{3}$, and hence $6^{\circ} = \frac{\pi}{30}$. You can check the accuracy of this approximation by noting that $\cos 66^{\circ} \approx 0.4067$.

Question 3

Without using a calculator, approximate 9.98^{98}. Here are some hints. First, 9.98 is close to 10, and $10^{98} = 1\,\mathrm{E}\,98$ in scientific notation. What does linear approximation give as an estimate when we decrease from 10^{98} to 9.98^{98}?

- $0.9804\,\mathrm{E}\,98$
- $1.960\,\mathrm{E}\,98$
- $0.902\,\mathrm{E}\,98$
- $0.822\,\mathrm{E}\,98$
- $0.804\,\mathrm{E}\,98$
- $1.000\,\mathrm{E}\,98$

Question 4

A diving-board of length L bends under the weight of a diver standing on its edge. The free end of the board moves down a distance

$$D = \frac{P}{3EI}\,L^3$$

where P is the weight of the diver, E is a constant of elasticity —that depends on the material from which the board is manufactured— and I is a moment of inertia. (These last two quantities will again make an appearance in Lectures 13 and 41, but do not worry about what exactly they mean now...)

Suppose our board has a length $L = 2\,\mathrm{m}$, and that it takes a deflection of $D = 20\,\mathrm{cm}$ under the weight of the diver. Use a linear approximation to estimate the deflection that it would take if its length was increased by $20\,\mathrm{cm}$.

- $23.5\,\mathrm{cm}$
- $26\,\mathrm{cm}$
- $26.6\,\mathrm{cm}$
- $22\,\mathrm{cm}$
- $24.8\,\mathrm{cm}$
- $25.7\,\mathrm{cm}$

Question 5

The golden ratio $\varphi = \dfrac{1+\sqrt{5}}{2}$ is a root of the polynomial $x^2 - x - 1$. If you use Newton's method to estimate its value, what is the appropriate update rule for the sequence x_n ?

- $x_{n+1} = x_n - \dfrac{2x_n - 1}{x_n^2 - x_n - 1}$
- $x_{n+1} = x_n + \dfrac{2x_n - 1}{x_n^2 - x_n - 1}$
- $x_{n+1} = x_n - \dfrac{x_n^2 - x_n - 1}{2x_n - 1}$
- $x_{n+1} = \dfrac{2x_n - 1}{x_n^2 - x_n - 1}$
- $x_{n+1} = \dfrac{x_n^2 - x_n - 1}{2x_n - 1}$
- $x_{n+1} = x_n + \dfrac{x_n^2 - x_n - 1}{2x_n - 1}$

Question 6

To approximate $\sqrt{10}$ using Newton's method, what is the appropriate update rule for the sequence x_n ?

- $x_{n+1} = \dfrac{x_n}{2} - \dfrac{10}{x_n}$
- $x_{n+1} = \dfrac{x_n}{2} - \dfrac{5}{x_n}$
- $x_{n+1} = \dfrac{x_n}{2} + \dfrac{5}{x_n}$
- $x_{n+1} = \dfrac{x_n}{2}$
- $x_{n+1} = x_n - \dfrac{2x_n}{x_n^2 - 10}$

- $x_{n+1} = x_n + \dfrac{2x_n}{x_n^2 - 10}$

Question 7

You want to build a square pen for your new chickens, with an area of $1200\,\mathrm{ft}^2$. Not having a calculator handy, you decide to use Newton's method to approximate the length of one side of the fence. If your first guess is $30\,\mathrm{ft}$, what is the next approximation you will get?

- 15.05
- 30.05
- 30
- -5
- 35
- 40

Question 8

You are in charge of designing packaging materials for your company's new product. The marketing department tells you that you must put them in a cube-shaped box. The engineering department says that you will need a box with a volume of $500\,\mathrm{cm}^3$. What are the dimensions of the cubical box? Starting with a guess of $8\,\mathrm{cm}$ for the length of the side of the cube, what approximation does one iteration of Newton's method give you? Round your answer to two decimal places.

- [ ] In accordance with the Honor Code, I certify that my answers here are my own work.

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