AMSC/CMSC 660 Quiz 3 , Fall 2009

Show all work. You may leave arithmetic expressions in any form that a calculator could evaluate. By putting your name on this paper, you agree to abide by the university's code of academic integrity in completing the quiz. Use no books, calculators, cellphones, other electronic devices, communication with others, scratchpaper, etc.

Name ____

1. (10) Suppose you are the director of the hospital ward for which we modeled the spread of an epidemic. Suppose that you know that the infection rate is $\tau = .20 \pm .05$. How would you determine a vaccination rate ν so that you are 90% sure that no more than 20% of the patients will be infected? (You may assume that no patients are moved and that the number of infectious days k is given.)

Note:

- There is some vagueness in this question, to allow for various levels of statistical training. You should write a reasonable definition of what you mean by "90% sure" (or "90% confident") and then base your answer on your definition.
- You may say that you would "run the model from Chap. 19 with parameters ..." without explaining what is in the model. The question is asking how you would use the model, not what is inside of it.

Adams-Bashforth Methods

$$
\begin{aligned}
y_{n+1} &= y_n + hf_n, \ \textit{error}: \frac{h^2}{2} y^{(2)}(\eta) \\
y_{n+1} &= y_n + \frac{h}{2}(3f_n - f_{n-1}), \ \textit{error}: + \frac{5h^3}{12} y^{(3)}(\eta) \\
y_{n+1} &= y_n + \frac{h}{12}(23f_n - 16f_{n-1} + 5f_{n-2}), \ \textit{error}: \frac{3h^4}{8} y^{(4)}(\eta)
\end{aligned}
$$

Adams-Moulton Methods

$$
\begin{aligned}
y_{n+1} &= y_n + hf_{n+1}, \ \textit{error}: -\frac{h^2}{2} y^{(2)}(\eta) \\
y_{n+1} &= y_n + \frac{h}{2}(f_n + f_{n+1}), \ \textit{error}: -\frac{h^3}{12} y^{(3)}(\eta) \\
y_{n+1} &= y_n + \frac{h}{12}(5f_{n+1} + 8f_n - f_{n-1}), \ \textit{error}: -\frac{h^4}{24} y^{(4)}(\eta)
\end{aligned}
$$

2. (10) Suppose we have used the Adams-Bashforth formula of order $k = 3$ as a predictor to obtain y^P_{n+1}, and the Adams-Moulton formula of order $k = 3$ as a corrector to obtain y^C_{n+1}. The current value of h is 10^{-2} and $|y_{n+1}| \approx 1$. The user wants local error less than 10^{-3}, and we calculate $|y^P_{n+1} - y^C_{n+1}| = .025$, so we need to retake the step. What values would you advise using for h and k? Why?