Section 9.5.4

Tuesday, February 27, 2024 1:04 PM

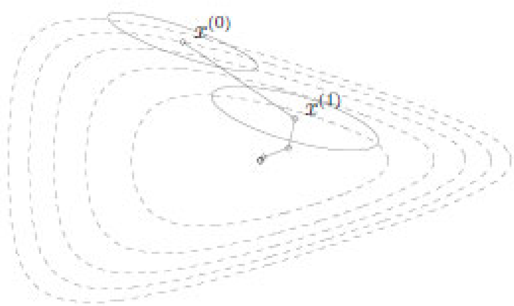
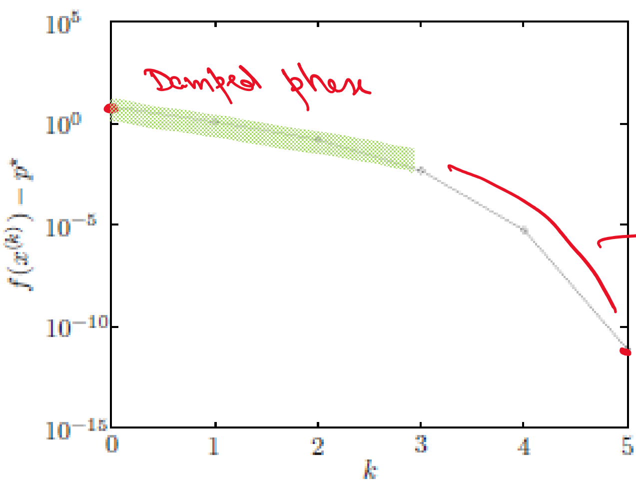


Figure 9.19 Newton's method for the problem in $\mathbf{R}^2$, with objective f given in (9.20), and backtracking line search parameters $\alpha = 0.1$, $\beta = 0.7$. Also shown are the ellipsoids $\{x \mid \|x - x^{(k)}\|_{\nabla^2 f(x^{(k)})} \le 1\}$ at the first two iterates.

$$f(x) = e^{x_1 + 3x_2 - 0.1} + e^{x_1 - 3x_2 - 0.1} + e^{-x_1 - 0.1}$$



Quadratic convergent phase

Figure 9.20 Error versus iteration k of Newton's method for the problem in $\mathbf{R}^2$. Convergence to a very high accuracy is achieved in five iterations.

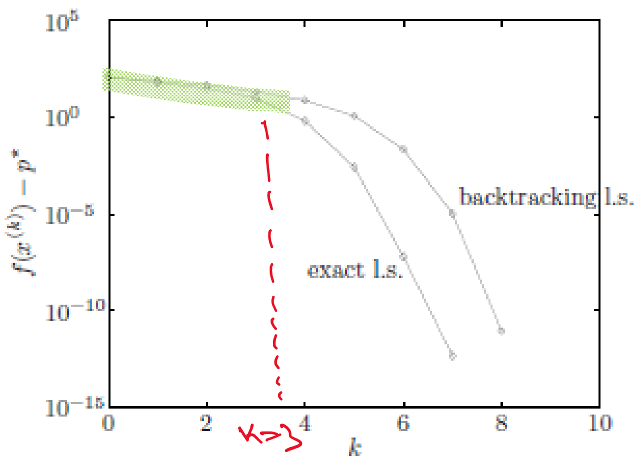
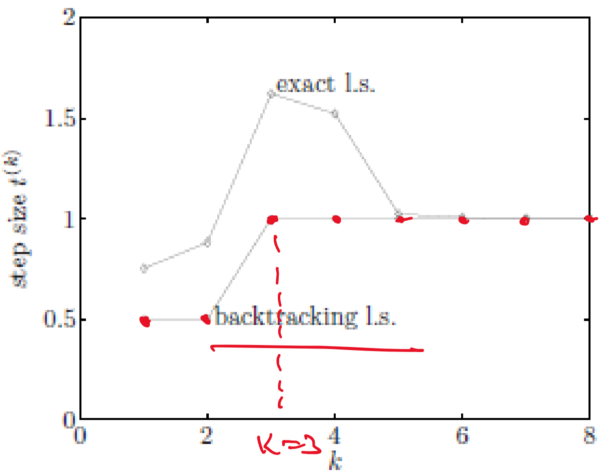


Figure 9.21 Error versus iteration for Newton's method for the problem in $\mathbf{R}^{100}$. The backtracking line search parameters are $\alpha = 0.01$, $\beta = 0.5$. Here too convergence is extremely rapid: a very high accuracy is attained in only seven or eight iterations. The convergence of Newton's method with exact line search is only one iteration faster than with backtracking line search.

$$f(x) = c^T x - \sum_{i=1}^{m} \log(b_i - a_i^T x)$$

$m = 500$

$n = 100$



$\beta = 0.5$

Figure 9.22 The step size t versus iteration for Newton's method with backtracking and exact line search, applied to the problem in $\mathbf{R}^{100}$. The backtracking line search takes one backtracking step in the first two iterations. After the first two iterations it always selects $t = 1$.

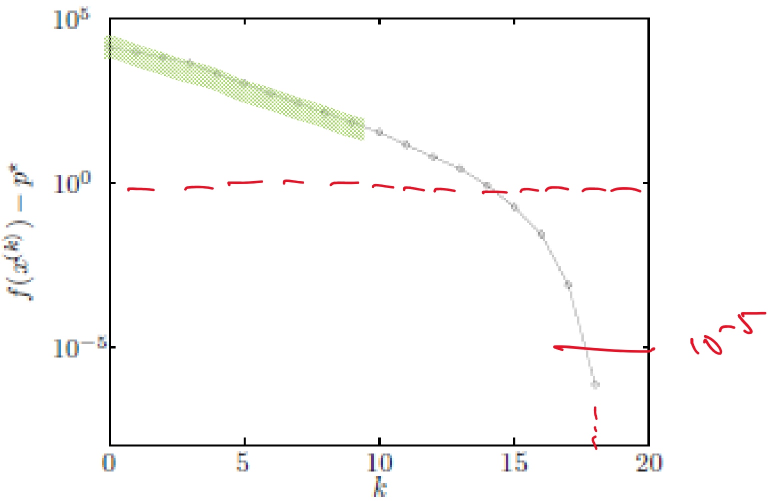


Figure 9.23 Error versus iteration of Newton's method, for a problem in $\mathbf{R}^{10000}$. A backtracking line search with parameters $\alpha = 0.01$, $\beta = 0.5$ is used. Even for this large scale problem, Newton's method requires only 18 iterations to achieve very high accuracy.