Optimization Application Notes

Example 1: For several weeks, the highway department has been recording the speed of the freeway traffic flowing past a certain downtown exit. The data suggest that between 1:00 and 6:00 pm on a normal weekday, the speed of the traffic at the exit is approximately $S(t) = t^3 - 10.5t^2 + 30t + 20$ miles per hour, where t is the number of hours past noon. At what time between 1:00 and 6:00 pm is the traffic moving the fastest, and at what time is it moving the slowest? What is the fastest and slowest speeds?

Example 2: The profit function for a particular commodity produced by a company can be modeled by $P(x) = -1.6x^2 + 19.2x - 40$, where *x* is measured in thousands and $P(x)$ is measured in thousands. Determine the level of production that results in maximum profit. What is the maximum profit?

Example 3: A manufacturer estimates that when x thousand units of a particular commodity are produced each month, the total cost will be $C(x) = 0.4x^2 - 3x + 40$ thousand dollars. At what level of production is the cost minimized?

Example 4: A psychologist measures a child's capability to learn and remember by the function $L(t) = \frac{-0.25t^4+t^3}{t+1}$, where t is the child's age in years, $0 \le t \le 5$. At what age does a child have the greatest learning capacity?

Example 5: A business manager estimates that when x thousand people are employed at her firm, the profit will be $P(x)$ million dollars, where $P(x) = \ln(4x + 1) + 3x - x^2$

a. What level of employment maximizes profit?
b. What is the maximum profit?

Example 6: Suppose that the monthly revenue in thousands of dollars, for the sale of x hundred units of an electric item is given by the function $R(x) = 40x^2e^{-0.4x} + 30$. Determine the number of units to produce in order to maximize revenue. What is the maximum revenue?