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Pollak, H. O.
A maximazation problem.
Consortium 106, 2-3 (2014).

From the text: COMAP has in recent years published two modeling situations that ultimately use the same mathematical problem: We have a function $f(t)$, defined for $t \geq 0$, with $f(0) = 0$ and $f(t)$ increasing to a finite limit as t gets large. We are given a finite $T > 0$, and we wish to find a value of $n \geq 1$ and a set of n values t_i, $1 \leq i \leq n$ such that $\sum_{i=1}^{n} f(t_i)$ is maximized. In the Safari model, you have T hours to spend in an African national park. A specific location is known to be good for one of the animals on your wish list, which you have a known probability $p(t)$ of seeing if you plan to spend time t there. One questionable assumption (of many) is that $p(t)$ does not depend on the animal that you hope to see in the given viewing spot; you are just in the best spot for that animal. In the air defense model, you have a stockpile of defensive weapons that you must divide among the locations to be defended, and if one attacker gets through, that location is lost. The attacker wants to maximize the expected number of locations at which he succeeds; the defense wants to minimize this but must decide ahead of time how many defensive weapons to station at each location. Our question is: Given that both models lead to the mathematical problem with which we began, how do you solve it? Difficulty: Students don't all think the same way, some prefer a geometric point of view, some analysis, and some a more discrete form of mathematics. What's unexpected about this problem is that there are three different approaches – one geometric, one analytic, and one discrete – that lead to the same result. There is one for each taste. That makes it worthwhile.

Classification: N60 I40 K20 M90
Keywords: extreme value problems; problem solving; geometric approach; discrete approach; analytic approach; slope of a line segment; slope of the tangent; combinatorics; sums; inequalities; optimization; differential calculus; intervals