

## HOMEWORK 4, Due December 8, 2020

**Problem statements that seem clear to one person may not be clear to another and it is difficult to fully specify all details and notes that could prevent you from interpreting these problem differently than intended. If you need clarification, please post to the Canvas Discussion Forum or contact the instructor or TA.**

1. (20 points) Use Returns Based Style Analysis (RBSA) to estimate the exposures of three funds contained in the data file 2020HW4.1.xlsx. The tab *Benchmarks* contains returns for a collection of benchmarks and the tab *Funds* contains the return series for each of the funds. What is the effective mix of each fund relative to the provided benchmarks?

### EXTRA CREDIT

Each problem is worth 3 extra credit points.

1. It turns out the profit per item for the Furniture Maker is not really linear in the number of chairs and tables produced. The actual profit functions are

Chairs	$10 \cdot C \cdot \ln(C) + 90C$
Tables	$250 \cdot T \cdot \ln(T) + 80T$

Prove that the objective function is convex and solve by adapting the AMPL furniture maker files. What is the optimal production schedule? Hint:  $\ln(0)$  is undefined.

2. Can we solve an optimization problem with the feasible region shown in Problem 1 of Homework 3? In 100 words or less, why (and how) or why not.
3. Prove that a non-increasing convex function of a concave function is convex.
4. Prove that the sum of convex functions is convex.
5. Calculate the Cholesky factorization of the following matrix by hand.

16	28	4	20
28	130	52	80
4	52	30	46
20	80	46	123

Your answer should be a lower triangular matrix if a Cholesky factorization exists or a demonstration that there is no factorization.