

Oct 20

(1)

- Start Markowitz model, quadratic programming, non-linear programming.
- Progress report \rightsquigarrow Tuesday, Oct 31 11:59 pm via email, hand in hardcopy after class Nov 1.
- I'll give a template by Monday; it will be graded out of 10 with no resubmittal
- If RESUBMIT on proposal, hand in revised proposal & original by Wednesday Oct 25
- Sample slides for proposal next week; 5 minute talk; you may give such a presentation during October, first week of November.

Markowitz model & non-linear (e.g. quadratic) programming.

- Quadratic programming $\xleftrightarrow{\text{close}}$ LP

- Gurobi and other software can solve LP, ILP, QP

Motivation through probabilities (Ch 24 Vanderbei)

SAMPLE STOCK DATA

JOEL FRIEDMAN

independent

CONTENTS

Coke = Pepsi = 8 1/2
 12 1/2
 Amazon =

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probability

	Event 1	Ev 2	Ev 3	Ev 4	avg	var
<i>p</i>	1/4	1/4	1/4	1/4		
Coke	8	8	12	12	10	4
Pepsi	8	8	12	12	10	4
Amazon	8	12	8	12	10	4
Anti-AMZ	12	8	12	8	10	4
Bond	9	9	9	9	9	0

Return on one unit

Formulas:

avg of Coke = $\bar{C} = C_1p_1 + C_2p_2 + C_3p_3 + C_4p_4 = 8(.25) + 8(.25) + 12(.25) + 12(.25) = 10$
 var of Coke =

DEPARTMENT OF COMPUTER SCIENCE, UNIVERSITY OF BRITISH COLUMBIA, VANCOUVER, BC V6T 1Z4, CANADA, AND DEPARTMENT OF MATHEMATICS, UNIVERSITY OF BRITISH COLUMBIA, VANCOUVER, BC V6T 1Z2, CANADA.
 E-mail address: jf@cs.ubc.ca or jf@math.ubc.ca
 URL: http://www.math.ubc.ca/~jf

average return; "risk"

③

risk = ?? variance: one model: ?

$C = \text{Colce} \pm 8$ (prob $\frac{1}{4}$), 8 (prob $\frac{1}{4}$), 12 (prob $\frac{1}{4}$), 12 (prob $\frac{1}{4}$)

average $\bar{C} = 10$,

variance: average $(C - \bar{C})^2 = (C - 10)^2$

$$(8-10)^2 \cdot \frac{1}{4} + (8-10)^2 \cdot \frac{1}{4} + (12-10)^2 \cdot \frac{1}{4} + (12-10)^2 \cdot \frac{1}{4} = 4$$

$\bar{C} = \text{avg return} = 10$, $\text{Var}(C) = 4$

Bond: values $9, 9, 9, 9$ in Events $1, 2, 3, 4$,

$\bar{B} = 9$, $\text{Var}(B) = 0$

=

Say I have one unit C , $\bar{C} = 10$, $\text{Var}(C) = 4$

Minimize variance \rightarrow discard my share of C

There are other measures of risk...

=

Say I can buy some shares of C

... get a gift ... C

Markowitz utility: = avg return - ~~all~~ Var

risk aversion const

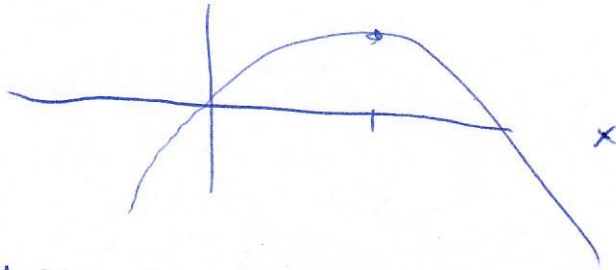
~~maximize~~ $x \geq 0$: x shares of C : avg return = $10x$
var = $4x^2$

I_s

(4)

max $10x - 4x^2$ s.t. $x \geq 0$

reasonable?



funds → held under mattress
→ bonds
→ riskier stock