

HOMEWORK 5
SA305, SPRING 2012
INSTRUCTOR: PHILLIPS

Due: Monday, 2/27 at 5pm.

Write or type up and hand in your formulations. **Clearly** indicate which problem your formulation corresponds to. **Be sure to use the NPS format and to adequately describe all variables, parameters, and constraints.** *You may email your formulations if you wish.*

A few points to keep in mind:

- **Please read each problem carefully as soon as you can!** E.g., be sure to understand whether the problem is indicating “Exercise” or “Example”! Also, your brain starts “working” on a problem as soon as you read it – even if it’s only unconscious – so read the problems ASAP.
- **Hand in all formulations on paper even if you have typed them and read them over carefully!** Starting with this homework, I’d like you all to hand in your formulations on paper. So, if you’ve typed them up, that’s fine, but please print them up and hand them in.

1. An investor is trying to determine a low-risk stock portfolio consisting 3 major indexes: the Dow Jones Industrial Average (DJIA), the Standard and Poor 500 index (SP500), and the NASDAQ (originally “National Association of Securities Dealers Automated Quotations”) index. The investor has data for the past 10 years of average return for each of the indexes:

Year	DJIA	SP500	NASDAQ
2002	-16.76%	-23.37%	-31.53%
2003	25.32%	26.38%	50.01%
2004	3.15%	8.99%	8.59%
2005	-0.61%	3.00%	1.37%
2006	16.29%	13.62%	9.52%
2007	6.43%	3.52%	9.81%
2008	-33.84%	-38.49%	-40.54%
2009	18.82%	23.45%	43.89%
2010	11.02%	12.78%	16.91%
2011	5.53%	0.00%	-1.80%

The investor makes the following assumptions:

- (1) The market always acts in a way that is **least** profitable to the investor.
- (2) The market acts according to history. Let r_{ij} denote the return rate for index j in year i (from the above table). The market’s return rate for the three indexes in 2012 is a weighted average of the previous ten years where the weights sum to one, i.e., the market “chooses” weights $y_{2002}, y_{2003}, \dots, y_{2011}$ where $\sum_{i=2002}^{2011} y_i = 1$ and then the return rates for 2012 are:

$$r_{2012, \text{DJIA}} = \sum_{i=2002}^{2011} y_i r_{i, \text{DJIA}}, \quad r_{2012, \text{SP500}} = \sum_{i=2002}^{2011} y_i r_{i, \text{SP500}}, \quad r_{2012, \text{NASDAQ}} = \sum_{i=2002}^{2011} y_i r_{i, \text{NASDAQ}}.$$

Formulate the investor’s problem as a linear program (*Hint: consider using the game theoretic maximin ideas from class*).

2. Exercise 2.36. Formulate only (do not solve).