Optimization in Practice: Salesforce Optimization

Similar methodology to the Campaign Expenditure example

- NLO models have been used to decide how large sales force (detailing resources) should be, and how it should be deployed (across different drugs/regions/physician specialties).

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Impact

"… 8% annual sales increase. The model had important impacts on the strategic direction of the firm, helping change its focus to product markets with better future potential."

Reference: Lodish et al. (1988) "Sales Force Sizing and Deployment Using a Decision Calculus Model at Syntex Laboratories", *Interfaces*.

Appendix (*OPTIONAL*)

Portfolio Optimization is a Nonlinear Optimization Problem

Recall the Portfolio Diversification Problem

	AMZN	HD	WMT
Expected return	3.23%	2.04%	1.08%
Risk (std. dev. of returns)	8.40%	5.26%	5.38%

correlation matrix

	AMZN	HD	WMT
AMZN			
HD	0.42		
WMT	0.11	0.19	

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AMZN			
HD	0.42		
WMT	0.11	0.19	

If we invest fractions $\boldsymbol{a}$, $\boldsymbol{b}$, and $\boldsymbol{c}$ in AMZN, HD, WMT, respectively, then:

Portfolio Expected Return [in %] $= 3.23\,\boldsymbol{a} + 2.04\,\boldsymbol{b} + 1.08\,\boldsymbol{c}$

Portfolio Risk [in %]

$$= \sqrt{\begin{matrix}\boldsymbol{a}^2\,(8.40)^2 + \boldsymbol{b}^2\,(5.26)^2 + \boldsymbol{c}^2\,(5.38)^2 \\ +2\boldsymbol{ab}\,(8.40)(5.26)(0.42) + 2\boldsymbol{ac}(8.40)(5.38)(0.11) + 2\boldsymbol{bc}(5.26)(5.38)(0.19)\end{matrix}}$$

Recall the Portfolio Diversification Problem (Lecture 2)

	AMZN	HD	WMT
Expected return	3.23%	2.04%	1.08%
Risk (std. dev. of returns)	8.40%	5.26%	5.38%

correlation matrix

	AMZN	HD	WMT
AMZN			
HD	0.42		
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If we invest fractions $\boldsymbol{a}$, $\boldsymbol{b}$, and $\boldsymbol{c}$ in AMZN, HD, WMT, respectively, then:

Portfolio Expected Return [in %] $= 3.23\,\boldsymbol{a} + 2.04\,\boldsymbol{b} + 1.08\,\boldsymbol{c}$

Nonlinear!

Portfolio Risk [in %]

$$= \sqrt{\begin{array}{c}\boldsymbol{a}^2\,(8.40)^2 + \boldsymbol{b}^2\,(5.26)^2 + \boldsymbol{c}^2\,(5.38)^2 \\ +2\boldsymbol{ab}\,(8.40)(5.26)(0.42) + 2\boldsymbol{ac}(8.40)(5.38)(0.11) + 2\boldsymbol{bc}(5.26)(5.38)(0.19)\end{array}}$$

Formulation As a Nonlinear Optimization Problem

	Model 1	Model 2
Decision variables	**a**, **b**, **c**	**a**, **b**, **c**
Objective function	maximize Portfolio Expected Return	minimize Portfolio Risk
Constraints	**a** + **b** + **c** = 1	**a** + **b** + **c** = 1
	Portfolio Risk ≤ user-specified threshold	Portfolio Expected Return ≥ user-specified threshold
	a, **b**, **c** ≥ 0	**a**, **b**, **c** ≥ 0