

# Lattice Allocations: A better way to do cost allocations

Kirke Bent, Dennis Caplan

# Abstract

- Introduces a new technique for Cost Allocation(Lattice Allocation)
- Benefits:
  - Easier to implement in Excel
  - Scales more easily
  - Matrices better represent costs
  - Easier to teach
- Future Research
  - Fast Close, Continuous Reporting, and government cost accounting.

# Agenda

- Types of Costs
- Cost Allocation
- Direct Cost Allocation
- Step-Down Cost Allocation
- Reciprocal Cost Allocation
- Lattice Cost Allocation

# Definitions(Comes up on AP econ once)

- Variable vs. Fixed
- Manufacturing Overhead
- Product vs. Period

# Why Cost Allocation?

- Definition: Allocating Overhead to Operating Activities
- *Strongly recommended*(RE:required) by GAAP and required by IFRS
- Long-term vs. Short-Term Decision Making (Absorption costing vs. Variable costing)

# Cost Center Allocation Example

Includes Service Departments e.g. Janitorial Department, Administrative Department

# Direct Cost Allocation

- Constant Cost Pool per dept
- One Allocation Base per dept (e.g. Direct Labor Hours, Machine Hours, Direct Materials, etc.)

# Excel Model

Department: ▾	Janit. Dept. ▾	Admin. Dept. ▾	Math Dept. ▾	Science Dept. ▾	Total ▾
Square Footage			40,000	100,000	140,000
Direct Labor Hours			130,000	70,000	200,000
SF Fraction	-100.0%	0.0%	28.6%	71.4%	0.0%
DLH Fraction	0.0%	-100.0%	65.0%	35.0%	0.0%
Janit. Allocation	\$ (200,000.00)	\$ -	\$ 57,142.86	\$ 142,857.14	\$ -
Admin. Allocation	\$ -	\$ (600,000.00)	\$ 390,000.00	\$ 210,000.00	\$ -
Department Costs	\$ 200,000.00	\$ 600,000.00	\$ 1,000,000.00	\$ 1,000,000.00	\$ 2,800,000.00
Total Allocated	\$ (200,000.00)	\$ (600,000.00)	\$ 447,142.86	\$ 352,857.14	\$ -
Total Cost	\$ -	\$ -	\$ 1,447,142.86	\$ 1,352,857.14	\$ 2,800,000.00



# Step-Down Cost Allocation

- One pool per department
- Multiple Departments

# Excel Model

Department: ▾	Janit. Dept. ▾	Admin. Dept. ▾	Math Dept. ▾	Science Dept. ▾	Total ▾
Square Footage		100,000	40,000	100,000	240,000
Direct Labor Hours			130,000	70,000	200,000
SF Fraction	-100.0%	41.7%	16.7%	41.7%	0.0%
DLH Fraction	0.0%	-100.0%	65.0%	35.0%	0.0%
Janit. Allocation	\$ (200,000.00)	\$ 83,333.33	\$ 33,333.33	\$ 83,333.33	\$ -
Admin. Allocation	\$ -	\$ (683,333.33)	\$ 444,166.67	\$ 239,166.67	\$ -
Department Costs	\$ 200,000.00	\$ 600,000.00	\$ 1,000,000.00	\$ 1,000,000.00	\$ 2,800,000.00
Total Allocated	\$ (200,000.00)	\$ (600,000.00)	\$ 477,500.00	\$ 322,500.00	\$ -
Total Cost	\$ -	\$ -	\$ 1,477,500.00	\$ 1,322,500.00	\$ 2,800,000.00

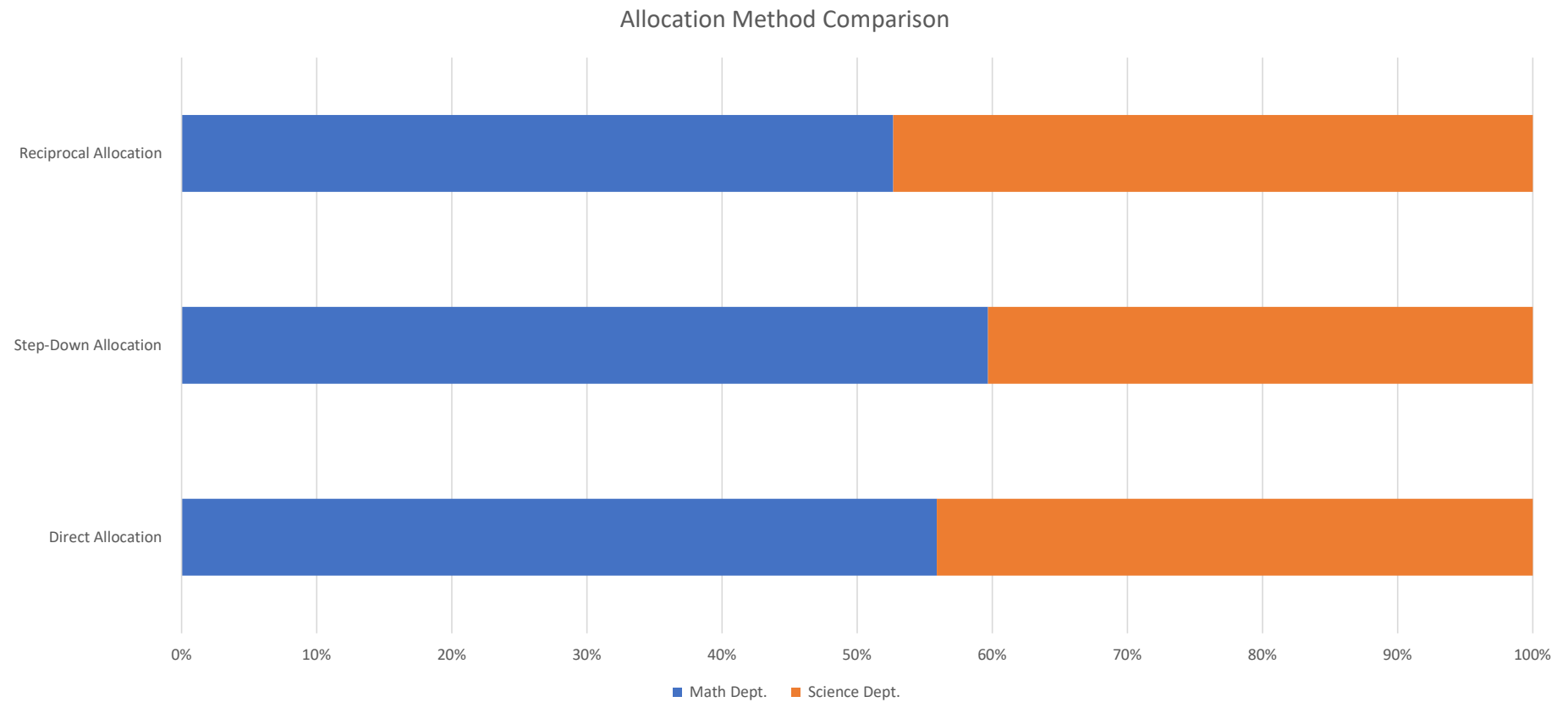
# Reciprocal Cost Allocation

- Overhead costs flow both ways
- More Accurate, Harder to manipulate
- Linear equations

# Excel Model

Department: ▾	Janit. Dept. ▾	Admin. Dept. ▾	Math Dept. ▾	Science Dept. ▾	Total ▾
Square Footage		100,000	40,000	100,000	240,000
Direct Labor Hours	100,000		130,000	70,000	300,000
SF Fraction	-100.0%	41.7%	16.7%	41.7%	0.0%
DLH Fraction	33.3%	-100.0%	43.3%	23.3%	0.0%
L1.1	-206.7%	0.0%	83.3%	123.3%	0.0%
L2.1	0.0%	-620.0%	352.0%	268.0%	0.0%
L1.2	100.0%	0.0%	-40.3%	-59.7%	0.0%
L2.2	0.0%	100.0%	-56.8%	-43.2%	0.0%
Janit. Allocation	\$ (200,000.00)	\$ -	\$ 80,645.16	\$ 119,354.84	\$ -
Admin. Allocation	\$ -	\$ (600,000.00)	\$ 340,645.16	\$ 259,354.84	\$ -
Department Costs	\$ 200,000.00	\$ 600,000.00	\$ 1,000,000.00	\$ 1,000,000.00	\$ 2,800,000.00
Total Allocated	\$ (200,000.00)	\$ (600,000.00)	\$ 421,290.32	\$ 378,709.68	\$ -
Total Cost	\$ -	\$ -	\$ 1,421,290.32	\$ 1,378,709.68	\$ 2,800,000.00

# Why does this matter?



What are we looking for?

Department: ▾	Janit. Dept. ▾	Admin. Dept. ▾	Math Dept. ▾	Science Dept. ▾	Total ▾
L1.2	100.0%	0.0%	-40.3%	-59.7%	0.0%
L2.2	0.0%	100.0%	-56.8%	-43.2%	0.0%

$$\begin{bmatrix} -1.0 & 0 & 0.403 & 0.597 \\ 0 & -1.0 & 0.568 & 0.432 \end{bmatrix}$$

Add the identity Matrix

$$\begin{bmatrix} 0 & 0 & 0.403 & 0.597 \\ 0 & 0 & 0.568 & 0.432 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

# What does this represent?

$$\begin{bmatrix} 200000 & 600000 & 1000000 & 1000000 \end{bmatrix} \cdot \begin{bmatrix} 0 & 0 & 0.403 & 0.597 \\ 0 & 0 & 0.568 & 0.432 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} = \begin{bmatrix} 0 & 0 & 1.4214 \times 10^6 & 1.3786 \times 10^6 \end{bmatrix}$$

Department: ▾	Janit. Dept. ▾	Admin. Dept. ▾	Math Dept. ▾	Science Dept. ▾	Total ▾
Total Cost	\$ -	\$ -	\$ 1,421,290.32	\$ 1,378,709.68	\$ 2,800,000.00



# Stable State

$$\begin{bmatrix} 0 & 0 & 0.403 & 0.597 \\ 0 & 0 & 0.568 & 0.432 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \cdot \begin{bmatrix} 0 & 0 & 0.403 & 0.597 \\ 0 & 0 & 0.568 & 0.432 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} = \begin{bmatrix} 0 & 0 & 0.403 & 0.597 \\ 0 & 0 & 0.568 & 0.432 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

# Matrices

Department: ▾	Janit. Dept. ▾	Admin. Dept. ▾	Math Dept. ▾	Science Dept. ▾	Total ▾
SF Fraction	-100.0%	41.7%	16.7%	41.7%	0.0%
DLH Fraction	33.3%	-100.0%	43.3%	23.3%	0.0%

$$A = \begin{bmatrix} 0 & 0.417 & 0.167 & 0.417 \\ 0.333 & 0 & 0.433 & 0.233 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

# Lattice Allocation

$$\begin{bmatrix} 0 & 0.417 & 0.167 & 0.417 \\ 0.333 & 0 & 0.433 & 0.233 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}^2 = \begin{bmatrix} 0.138861 & 0 & 0.347561 & 0.514161 \\ 0 & 0.138861 & 0.488611 & 0.371861 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

$$\begin{bmatrix} 0 & 0.417 & 0.167 & 0.417 \\ 0.333 & 0 & 0.433 & 0.233 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}^4 = \begin{bmatrix} 0.0192824 & 0 & 0.395824 & 0.585558 \\ 0 & 0.0192824 & 0.55646 & 0.423498 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

# Comparison

$$\text{LA: } \begin{bmatrix} 0 & 0.417 & 0.167 & 0.417 \\ 0.333 & 0 & 0.433 & 0.233 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}^8 = \begin{bmatrix} 3.7181 \times 10^{-4} & 0 & 0.403456 & 0.596849 \\ 0 & 3.7181 \times 10^{-4} & 0.56719 & 0.431664 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

$$\text{Row Reduction: } \begin{bmatrix} 0 & 0 & 0.403 & 0.597 \\ 0 & 0 & 0.568 & 0.432 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

# Further Questions

- What other uses does this have?
- Eigenvalues?

# Sources

Kirke Bent, Dennis Caplan, “Lattice allocations: A better way to do cost allocations” *Advances in Accounting*, Volume 38, 2017, Pages 99-105, ISSN 0882-6110, <https://doi.org/10.1016/j.adiaac.2017.07.008>.

Garrison, R. H., Noreen, E. W., & Brewer, P. C. (2017). *Managerial accounting* (16th ed.). McGraw-Hill Education.