budget maths

or $z = B1^T\gamma$

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Abstract

- Let's write the formula chain that calculates the budget.
- γ is the scalar costbase.
- k, p, q,1 are k-dimensional vectors, respectively for cost distribution, price, quantity, column-vector of 1's (where k is the number of cost centres to be distinguished).
- z, b are the z-dimensional vectors resp. for budget and observed budget distribution (where z is the number of budget lines to be distinguished)

Formulas

- $k\gamma = p * q$ (Hadamart product, element-wise)
- $B = bk^T$(a z by k matrix)
- $z = B1^T\gamma$ (Matrix multiplication)

Example

```
gamma <- 1000
b <- purrr::set_names(c(0.55, 0, 0.20, 0.25), paste0("Z",1:4))
k <- purrr::set_names(c(0.1, 0.6, 0.15, 0.10, 0.05), paste0("dg",0:4))
B <- b %*% t(k)
one <- 1+0*k
z <- c(B %*% one * gamma) %>% purrr::set_names(names(b))
```

- γ costbase

gamma
1000

- **z** (the final result) and **b** (the distribution z-vector)

z	b
550	0.55
0	0.00
200	0.20
250	0.25

- **k** (the cost distribution over cost centres, e.g. DGs, is driven by staff quantity and unit price)

k
0.10

k
0.60
0.15
0.10
0.05

- $B = bk^T$

dg0	dg1	dg2	dg3	dg4
0.055	0.33	0.0825	0.055	0.0275
0.000	0.00	0.0000	0.000	0.0000
0.020	0.12	0.0300	0.020	0.0100
0.025	0.15	0.0375	0.025	0.0125

- $z = B1^T\gamma$ see result above

Notation

- Scalar multiplication $z = y\alpha$
- Vector addition $y = x + y$
- Matrix / Vector multiplication $C = AB$ or $z = Bk$