

1. Context for Weighted Voting

- founders of a company where # votes is proportional to shares
- US House : States get # representatives (votes) base on population

2. Notation and Terminology for Weighted Voting

- players : people/entities voting. Denoted P_1, P_2, P_3, \dots
- weight of a player : the number of votes a player gets. denoted w_1, w_2, w_3, \dots . So player P_1 gets w_1 votes.
- total weight of the voting system : the sum of weights of all players.
- quota : minimum number of votes needed to approve a motion/action
- coalition : a group of players who vote together
- winning coalition : a coalition whose weights sum to the quota or more. If they vote together, they can pass a motion.
- critical player : a player in a winning coalition whose removal would cause the coalition to no longer be winning

3. Notation for a weighted voting system: [25: 11, 11, 10, 8]

Unpack notation:

 q, w_1, w_2, w_3, w_4

player	weight
P_1	11
P_2	11
P_3	10
P_4	8

$$\text{quota} = 25; \text{ total weight} = 11 + 11 + 10 + 8 = 40$$

coalition	weight	winning?
P_1, P_2	$11 + 11 = 22 < 25$	No
P_1, P_2, P_3	$11 + 11 + 10 = 32 > 25$	Yes
P_1, P_2, P_3, P_4	$11 + 10 + 8 = 29 > 25$	Yes
P_1, P_2, P_3, P_4	40	Yes

Who is
CRITICAL
here?

4. Reasonable Limits on the Quota

Suppose $q = \text{quota}$ and $T = \text{total weight} = w_1 + w_2 + \dots + w_n$

- $q \leq T$ (Otherwise you can't pass anything!)
- $q > \frac{T}{2}$ (We want to require majority support.)

5. A Look at Power

(a) A Dictator

[25: 25, 10, 3, 2], total weight = 40

$$40 - 10 - 3 - 2 = 25$$



- Someone with weight $w_i \geq q$ quota.
- Someone who can reach the quota alone.
- A dictator does not need any other player to form a winning coalition.
- Ex] Player 1 is a dictator because $w_1 = 25 \geq 25 = q$.

(b) Having Veto Power

[25: 21, 11, 5, 3], total weight = 40

- A player has veto power if they are a member of EVERY winning coalition.
- A player has veto power if the remaining players cannot form a winning coalition.
- Ex: P_1 has veto power because coalition P_2, P_3, P_4 has weight $11 + 5 + 3 = 19 < 25$

(c) A Dummy

[25: 20, 18, 1, 1], total weight = 40

$$40 - 20 - 18 = 2$$

(We don't have players with zero weight)

- A dummy is a player who is never critical.
- In any winning coalition, a dummy player can be lost and the coalition still wins.
- Ex] P_3 and P_4 are both dummies.
Aside: P_1 and P_2 both have veto power
- Q] Any dummies in example b? example a?)