Please Fill Out All of Your Courses Teaching Evals

May 10, 2022

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7) **Please Fill Out the Teaching Evals in All of your Courses**

How to Use the Half Method
(1) Given Upper Bound
(2) NOT Given Upper Bound

May 10, 2022

How Your Program Shows $f(45, 26) \leq \frac{32}{78}$

May 10, 2022

Your Programs FC Step on $f(45, 26)$

$$f(m,s) \leq \max\left\{\frac{1}{3}, \min\left\{\frac{m}{s} \times \frac{1}{\lceil 2m/s \rceil}, 1 - \frac{m}{2} \times \frac{1}{\lfloor 2m/s \rfloor}\right\}\right\}.$$

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$\frac{2m}{s} = \frac{90}{26} = \frac{45}{13} \sim 3.46$ $\quad \left\lfloor \frac{2m}{s} \right\rfloor = 3$ $\quad \left\lceil \frac{2m}{s} \right\rceil = 4$

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$$f(45,26) \le \max\left\{\frac{1}{3}, \min\left\{\frac{45}{26}\times\frac{1}{4}, 1-\frac{45}{26}\times\frac{1}{3}\right\}\right\} = \min\left\{\frac{45}{104}, 1-\frac{15}{26}\right\}$$

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$$f(45,26) \le \max\left\{\frac{1}{3}, \min\left\{\frac{45}{26} \times \frac{1}{4}, 1 - \frac{45}{26} \times \frac{1}{3}\right\}\right\} = \min\left\{\frac{45}{104}, 1 - \frac{15}{26}\right\}$$

$$= \min\left\{\frac{45}{104}, \frac{11}{26}\right\} = \frac{11}{26} \sim 0.423$$

We want $f(m,s) \le \frac{32}{78} \sim 0.410$. So FC NOT powerful enough.

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Buddy is $\leq 1 - \frac{45}{52} = \frac{7}{52} < \frac{32}{78}$.

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If someone gets ≥ 5 shares then $\exists$ a share $\leq \frac{45}{26} \times \frac{1}{5} = \frac{9}{26} < \frac{32}{78}$.

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$V = 4$.

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Some students gets 3 shares.
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Equations Step

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14 students get 3 shares

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12 students get 4 shares

Note:

there are $3 \times 14 = 42$ 3-shares

there are $4 \times 12 = 48$ 4-shares.

Equations Step

$$3s_3 + 4s_4 = 90$$
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14 students get 3 shares

12 students get 4 shares

Note:

there are $3 \times 14 = 42$ 3-shares

there are $4 \times 12 = 48$ 4-shares.

Note One way for HALF to not work is if these equations have a solution that is not in $\mathbb{N}$.

The β Step

$$\underset{\frac{32}{78}}{(}\quad \text{48 4-shs} \quad \underset{\beta}{)[} \quad 0 \quad \underset{\gamma}{](} \quad \text{42 3-shs} \quad \underset{\frac{46}{78}}{)}$$

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Want if $\exists$ 4-share $\geq \beta$ then some piece $\leq \frac{32}{78}$.

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Alice has $p_1 \leq p_2 \leq p_3 \leq p_4$.

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Want if $\exists$ 4-share $\geq \beta$ then some piece $\leq \frac{32}{78}$.

Alice has $p_1 \leq p_2 \leq p_3 \leq p_4$.
Assume $p_4 \geq \beta$ and later pick β to get a contradiction.
$p_1 + p_2 + p_3 + p_4 = \frac{45}{26}$
$p_1 + p_2 + p_3 = \frac{45}{26} - p_4 \leq \frac{45}{26} - \beta$

The β Step

$$\underset{\frac{32}{78}}{(} \quad 48\ \text{4-shs} \quad \underset{\beta}{)[} \quad 0 \quad \underset{\gamma}{](} \quad 42\ \text{3-shs} \quad \underset{\frac{46}{78}}{)}$$

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$p_1 + p_2 + p_3 = \frac{45}{26} - p_4 \leq \frac{45}{26} - \beta$
$p_1 \leq \frac{1}{3}(\frac{45}{26} - \beta)$. Want β so that $p_1 \leq \frac{32}{78}$:

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$$\underset{\frac{32}{78}}{(}\quad 48 \text{ 4-shs} \quad \underset{\beta}{)[}\quad 0 \quad \underset{\gamma}{](}\quad 42 \text{ 3-shs} \quad \underset{\frac{46}{78}}{)}$$

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$\frac{1}{3}(\frac{45}{26} - \beta) \leq \frac{32}{78}$
$\beta \geq \frac{39}{78} = \frac{1}{2}$. Take $\beta = \frac{39}{78}$.

The γ Step (What you Really Want to See)

$$\underset{\frac{32}{78}}{(}\quad 48 \text{ 4-shs} \quad \underset{\beta}{)[} \quad 0 \quad \underset{\gamma}{](} \quad 42 \text{ 3-shs} \quad \underset{\frac{46}{78}}{)}$$

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Want if $\exists$ 3-share $\leq \gamma$ then some piece $\leq \frac{32}{78}$.

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$p_3 \ge \frac{1}{2}(\frac{45}{26} - \gamma)$. **Key** Look at buddy of p_3.

$1 - p_3 \le 1 - \frac{1}{2}(\frac{45}{26} - \gamma)$. Want γ so that $1 - p_3 \le \frac{32}{78}$:

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$1 - p_3 \le 1 - \frac{1}{2}(\frac{45}{26} - \gamma)$. Want γ so that $1 - p_3 \le \frac{32}{78}$:

$1 - \frac{1}{2}(\frac{45}{26} - \gamma) \le \frac{32}{78}$.

$\gamma \le \frac{43}{78}$. Take $\gamma = \frac{43}{78}$.

VHALF Step

There are 42 3-shares.
There are 48 4-shares

$$\beta = \frac{1}{2} \leq \frac{1}{2} \leq \gamma = \frac{43}{78}$$

$42 \neq 48$ so SUCCESS!

VHALF Step

There are 42 3-shares.
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$$\beta = \frac{1}{2} \le \frac{1}{2} \le \gamma = \frac{43}{78}$$

$42 \neq 48$ so SUCCESS!

Note One way for the HALF method to fail is if $\gamma < \beta$

How Your Program Finds the Answer

May 10, 2022

V-Step and Equation Step

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$$V = \left\lceil \frac{2m}{s} \right\rceil = \left\lceil \frac{90}{26} \right\rceil = 4.$$

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$$s_3 = 14$$

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$\beta = \frac{1}{2}$-Step

$$\underset{\alpha}{(}\quad 48\ \text{4-shs} \quad \underset{\beta}{)[} \quad 0 \quad \underset{\gamma}{](} \quad 42\ \text{3-shs} \quad \underset{1-\alpha}{)}$$

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We **want** to set α so that $\beta = \frac{1}{2}$.

Alice has $p_1 \le p_2 \le p_3 \le p_4$.

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$p_1 + p_2 + p_3 = \frac{45}{26} - p_4 \le \frac{45}{26} - \frac{1}{2}$

$\beta = \frac{1}{2}$-Step

$$
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$p_1 \le \frac{1}{3}(\frac{45}{26} - \frac{1}{2})$. Want α so that $p_1 \le \alpha$:

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$p_1 \le \frac{1}{3}(\frac{45}{26} - \frac{1}{2})$. Want α so that $p_1 \le \alpha$:
$\frac{1}{3}(\frac{45}{26} - \frac{1}{2}) = \frac{32}{78}$.
We note that there are $48 > 45$ 4-shares that are all $\le \frac{1}{2}$.
So we have $\frac{32}{78}$ is an upper bound.

The $\gamma = \frac{1}{2}$ Step (What you Really Want to See)

$$\underset{\alpha}{(}\quad \text{48 4-shs} \quad \underset{\beta}{)[}\quad 0 \quad \underset{\gamma}{](}\quad \text{42 3-shs} \quad \underset{1-\alpha}{)}$$

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$p_1 + p_2 + p_3 = \frac{45}{26}$
$p_2 + p_3 = \frac{45}{26} - \frac{1}{2}$

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$p_2 + p_3 = \frac{45}{26} - \frac{1}{2}$
$p_3 \ge \frac{1}{2}(\frac{45}{26} - \frac{1}{2})$. **Key** Look at buddy of p_3.

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$p_2 + p_3 = \frac{45}{26} - \frac{1}{2}$
$p_3 \geq \frac{1}{2}(\frac{45}{26} - \frac{1}{2})$. **Key** Look at buddy of p_3.
$1 - p_3 \leq 1 - \frac{1}{2}(\frac{45}{26} - \frac{1}{2})$. Want α so that $1 - p_3 \leq \alpha$:

The $\gamma = \frac{1}{2}$ Step (What you Really Want to See)

$$\begin{array}{ccccccc} (& \text{48 4-shs} &)[& 0 &](& \text{42 3-shs} &) \\ \alpha & & \beta & & \gamma & & 1-\alpha \end{array}$$

Want if $\exists$ 3-share $\le \gamma = \frac{1}{2}$ then some piece $\le \alpha$.

Bob has $p_1 \le p_2 \le p_3$.
Assume $p_1 \le \frac{1}{2}$ and later pick α to get a contradiction.
$p_1 + p_2 + p_3 = \frac{45}{26}$
$p_2 + p_3 = \frac{45}{26} - \frac{1}{2}$
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$1 - \frac{1}{2}(\frac{45}{26} - \frac{1}{2}) = \frac{5}{13}$.

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So answer is $\frac{32}{78}$.