

$$\begin{vmatrix} 0 & 0 & a_1 & b_1 \\ 0 & 0 & a_r & b_r \\ a_r & b_r & 0 & 0 \\ a_f & b_f & 0 & 0 \end{vmatrix} = a_r(b_f(a_1b_r - b_1a_r)) - b_r(a_f(a_1b_r - b_1a_r)) \\ = (a_1b_r - a_rb_1)(a_fb_f - a_fb_r)$$

$$\begin{vmatrix} a_1 & 0 & 0 & b_1 \\ 0 & a_r & b_r & 0 \\ 0 & b_r & a_r & 0 \\ b_f & 0 & 0 & a_f \end{vmatrix} = \begin{vmatrix} a_1 & 0 & 0 & b_1 \\ 0 & a_r & b_r & 0 \\ 0 & b_r & a_r & 0 \\ 0 & 0 & 0 & a_f - b_1 \times \frac{b_f}{a_1} \end{vmatrix}$$

$$\begin{vmatrix} a_1 & 0 & 0 & b_1 \\ 0 & a_r & b_r & 0 \\ 0 & 0 & a_r - b_r \times \frac{b_r}{a_r} & 0 \\ 0 & 0 & 0 & a_f - b_1 \times \frac{b_f}{a_1} \end{vmatrix} = a_1 \times a_r \times (a_r - \frac{b_r \times b_r}{a_r}) (a_f - \frac{b_1 \times b_f}{a_1}) \\ = (a_1a_r - b_1b_r)(a_1a_f - b_1b_f)$$

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