Because we are given $\frac{x_i}{y_i}(1 \le i \le n)$, to find all the correct values of fractions $\frac{x_i}{c_i}$, we only need to find E. Because y_i, c_i and E are all greater than 1, the possible value of E is 1, 2, $\ldots\ldots y_i - 1$ for all y_i. Since E is equal for all y_i, the possible value of E is 1, 2, $\ldots\ldots$ $\min\{y_i: 1, \le i \le n\} - 1$. Otherwise, if E exceed $\min\{y_i: 1, \le i \le n\} - 1$, $\min\{c_i: 1, \le i \le n\} = \min\{y_i: 1, \le i \le n\} - \mathrm{E} \le 0$, which is impossible. To determine is E the exact value we are finding, we calculate $\sum_{i=1}^{n} \frac{x_i}{c_i}$ and compare it with S. If calculated sum is smaller, our calculated c_i is too big, E is smaller than the correct value and vice versa. $O(n)$

We can start finding E from a random number E's range. Then keep doing binary searches in E's range to find out the exact E. Instead of comparing with the median, we use above method to determine whether the value is too big or too small or exact. $O(n \log \min\{y_i: 1, \le i \le n\})$