

Let $C = \begin{bmatrix} c_{11} & c_{12} & \dots & c_{1n} \\ c_{21} & c_{22} & \dots & c_{2n} \\ c_{31} & c_{32} & \dots & c_{3n} \\ \dots & \dots & \dots & \dots \\ c_{n1} & c_{n2} & \dots & c_{nn} \end{bmatrix}$, where $c_{st} = \mu\left(\frac{s}{(s,t-1)}\right) \frac{\phi(2s)}{\phi\left(\frac{s}{(s,t-1)}\right)}$, $1 \leq s \leq n$,
 $1 \leq t \leq n$, and $n \geq 3$.

Example when $n = 10$:

$$C = \begin{bmatrix} 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \\ 2 & -2 & 2 & -2 & 2 & -2 & 2 & -2 & 2 & -2 \\ 2 & -1 & -1 & 2 & -1 & -1 & 2 & -1 & -1 & 2 \\ 4 & 0 & -4 & 0 & 4 & 0 & -4 & 0 & 4 & 0 \\ 4 & -1 & -1 & -1 & -1 & 4 & -1 & -1 & -1 & -1 \\ 4 & 2 & -2 & -4 & -2 & 2 & 4 & 2 & -2 & -4 \\ 6 & -1 & -1 & -1 & -1 & -1 & -1 & 6 & -1 & -1 \\ 8 & 0 & 0 & 0 & -8 & 0 & 0 & 0 & 8 & 0 \\ 6 & 0 & 0 & -3 & 0 & 0 & -3 & 0 & 0 & 6 \\ 8 & 2 & -2 & 2 & -2 & -8 & -2 & 2 & -2 & 2 \end{bmatrix}$$

I would need help to:

- i) Prove $\text{Det}(C) \neq 0$ for any $n \geq 3$.
- ii) Find C^{-1} for any $n \geq 3$.