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1° Introduction of convolution:

Take f, g on $\mathbb{Z}/n\mathbb{Z}$, def $F \triangleq \sum_{i=0}^{n-1} a_i f(i)$ to be generation fun. $G \triangleq \sum_{i=1}^{n-1} a_i g(i)$ let $a_i a_j = a_{i+j}$ $F \cdot G = (f(0)g(0) + f(1)g(n-1) + \cdots + f(n-1)g(1)) a_0 + \cdots$

find co-efficient of a_r: $\sum_{y \in \mathbb{Z}/n\mathbb{Z}} f(r-y) g(y) \triangleq f * g(r)$

which is convolution

2° $X+Y \xrightarrow{1} f_X * g_Y \xrightarrow{2} M_X \cdot M_Y$

1. For $P(X+Y \le r) = P(X \le k, Y \le r-k)$ ~~$= P(X \le k) P(Y \le r-k)$~~

If X, Y only takes the value on $\mathbb{Z}/n\mathbb{Z}$, $X+Y = r \in \mathbb{Z}/n\mathbb{Z}$

which is $P(X=0)P(Y=r) + P(X=1)P(Y=r-1) + \cdots + P(X=r)P(Y=0)$

$\triangleq \sum_{i=0}^{r} P(X=i) P(Y=r-i) = f_X * g_Y$

2. Choose $a_i = z^i$ in 1°, F is z-transformation of pdf of X

so $F \cdot G = M_X(t) \cdot M_Y(t)$, where $M_X(t) = \sum_{i=0}^{n-1} f_X(x) z^t$

and co-efficient of $\underset{\text{in } F \cdot G}{\underset{\sim}{t}}$: $f_X * g_Y(t)$

3° General: let G is a finite group, denote

$\mathbb{C}[G] \triangleq \{ (\sum c_i g_i)(\sum d_i g_i),\ g_i \in G \} \cong \{ f: G \to \mathbb{C} \}$

multiplication $\to f * g$.