Seminar 2021

Math

MIZUNO-TYPE RESULT AND WALLIS' FORMULA

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Abstract: Let $\Gamma^{\sim}(z)$ be the modified gamma function introduced by the authors in a recent preprint "arXiv2106.14674". In this note, we obtain the following Mizuno-type result:

$$\prod_{m=0}^{\infty}\left(\prod_{j=1}^{n}(m+z_j)\right)^{(-1)^m} = \frac{\sqrt{\pi/2}^{n}}{\prod_{j=1}^{n}\left(\Gamma^{\sim}(z_j)\right)},$$

which imply a Kurokawa–Wakayama type formula

$$\prod_{m=0}^{\infty}\left((m+x)^{n} - y^{n}\right)^{(-1)^m} = \frac{\sqrt{\pi/2}^{n}}{\prod_{\zeta^n=1}\left(\Gamma^{\sim}(x-\zeta y)\right)},$$

and a Lerch-type formula

$$\prod_{m=0}^{\infty}(m+x)^{(-1)^m} = \frac{\sqrt{\pi/2}}{\Gamma^{\sim}(x)}.$$

By setting x = 1 in the above result, we recover Wallis' 1656 formula

$$\frac{2\cdot 2}{1\cdot 3}\frac{4\cdot 4}{3\cdot 5}\frac{6\cdot 6}{5\cdot 7}\cdots = \frac{\pi}{2}.$$

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