Assume SnpByPopTeses save the score for each SNP, and

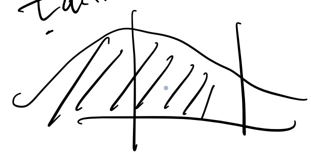
SnpByPopSE save the SE of the score.

let S_p and σ_p be the score and its SE.

① MAX Test.

let $T = \max_{1 \le p \le P} \left| \frac{S_i}{\sigma_i} \right|$

pnorm(T) is lower tail.



$$\text{pval} = 1 - (2\,\text{pnorm}(T) - 1)^P$$

② Meta Test

let $T = \sum_{1 \le i \le P} S_i \quad V = \sum_{1 \le i \le P} (\sigma_i)^2$

$$z = \left| \frac{T}{\sqrt{V}} \right|$$

$$\text{pval} = 2(1 - \text{pnorm}(z))$$

③ Fisher.

First convert the score to pvalue as

$$P_i = 2(1 - \text{pnorm}(\left|\frac{S_i}{\sigma_i}\right|))$$

Fisher Test Stat is $f = -2\sum_{i=1}^{P} \log(P_i)$. Its pvalue is based on chi-sq with 2P df.

④ ACAT. $P_i = 2(1 - \text{pnorm}(\left|\frac{S_i}{\sigma_i}\right|))$

$\text{ACAT} = \sum \tan((0.5 - P_i)\pi)$.

pvalue is based on a Cauchy distribution

→ same as in your code