Algorithm 1 Multivariate Generalization of Wald-Wolfowitz Test

Ensure: $length(matrix) = length(labels)$

  $matrix$

  $labels$

  $nperm \leftarrow 1000$

  $G \leftarrow graph(matrix, labels)$

  $MST \leftarrow MST(G)$

  $domain \leftarrow V(MST)$ ▷ vertices of MST

  $\overrightarrow{runs} = 0_{n_{perm}}$

  while $i \leq nperm$ **do**

    $randperm \leftarrow sample(domain)$ ▷ random sample of vertices

    $MST_2 \leftarrow MST$ ▷ Initialize new copy of MST

    $V(MST2) \leftarrow randperm$

    $runs[itr] \leftarrow 1 + neighboring\,vertices\,of\,MST2 \neq$

  end while

  $sdruns \leftarrow \sigma_{runs}$

  $Wperm \leftarrow \frac{runs - \mu_{runs}}{sdruns}$

  $runs - true \leftarrow 1 + neighboring\,vertices\,of\,MST \neq$

  $sdruns2 \leftarrow \sigma_{runs2}$

  $W - true \leftarrow \frac{run - true - \mu_{runs-true}}{sdruns2}$

  $pvalue \leftarrow \frac{(Wperm \leq W - true) + 1}{length(Wperm) + 1}$ **return** $pvalue, W - true, Wperm$