**Figure S1** Co-occurrence association between mutated genes.
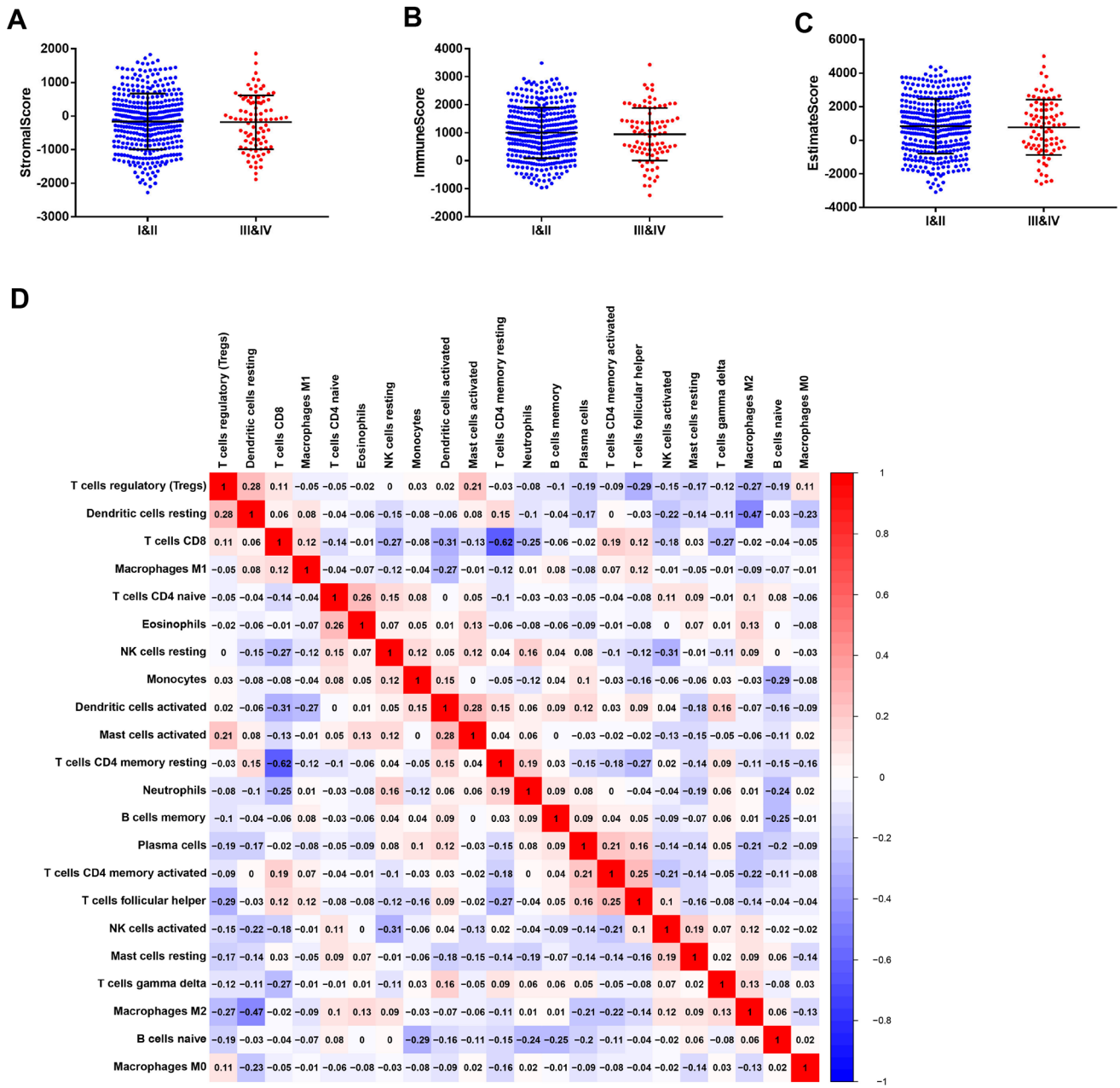
**Figure S2** Tumor microenvironment characterization analysis in LUSC. (A-C) Stromal, immune, and ESTIMATE scores t different pathological stages. (D) Correlations of immune cells. NK, natural killer.