Sex-assortativity, heterogeneity in infection and transmission by sex, and male-bias in TB cases: A simulation study

Take-aways for data exploration:

- Male-bias similar across regions
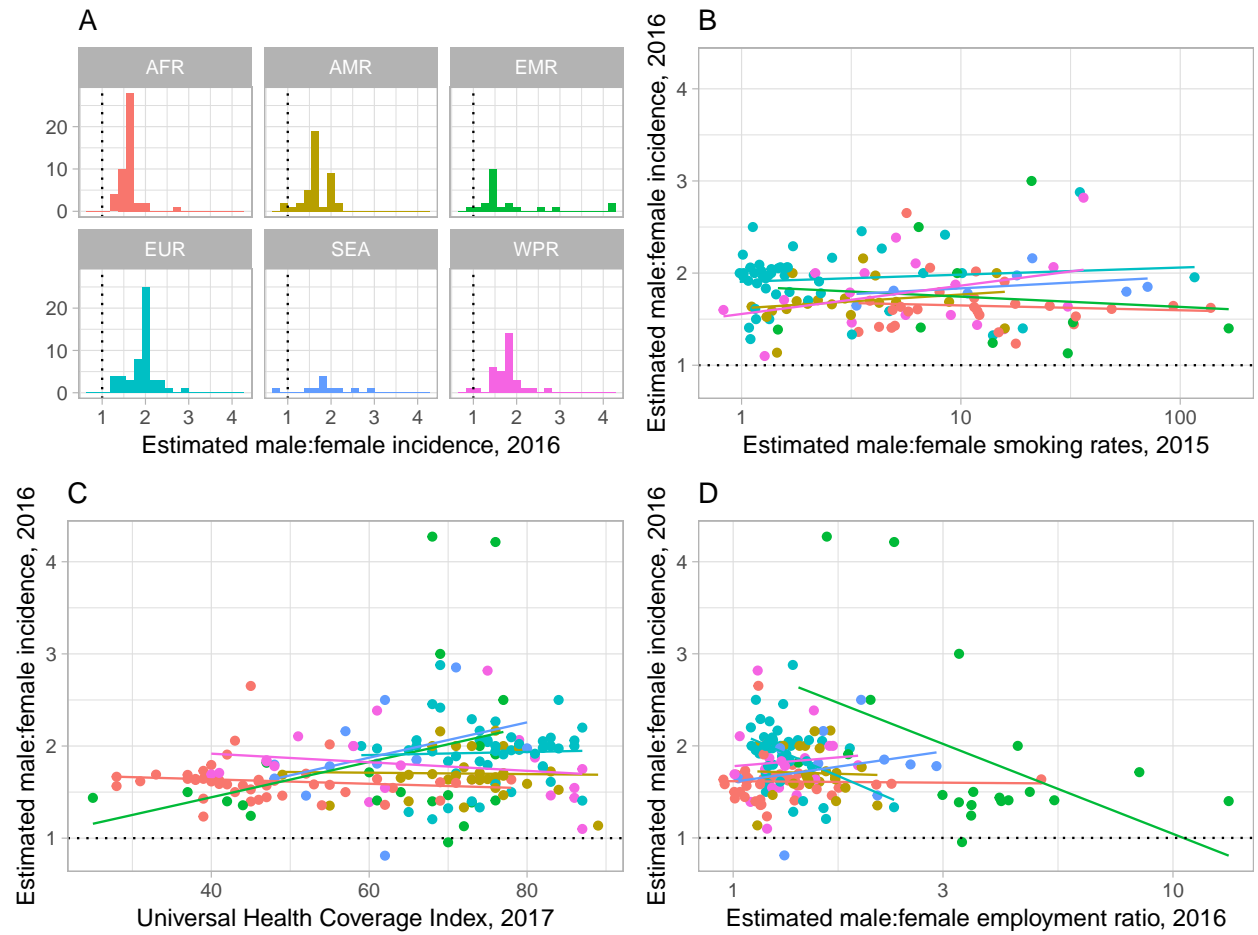- No strong predictors of male-bias at the country scale

Figure 1: Across the world, more cases of TB occur among men than women (A). These patterns are remarkably similar across regions and are not explained by rates of smoking (B), health coverage (C), or employment (D).
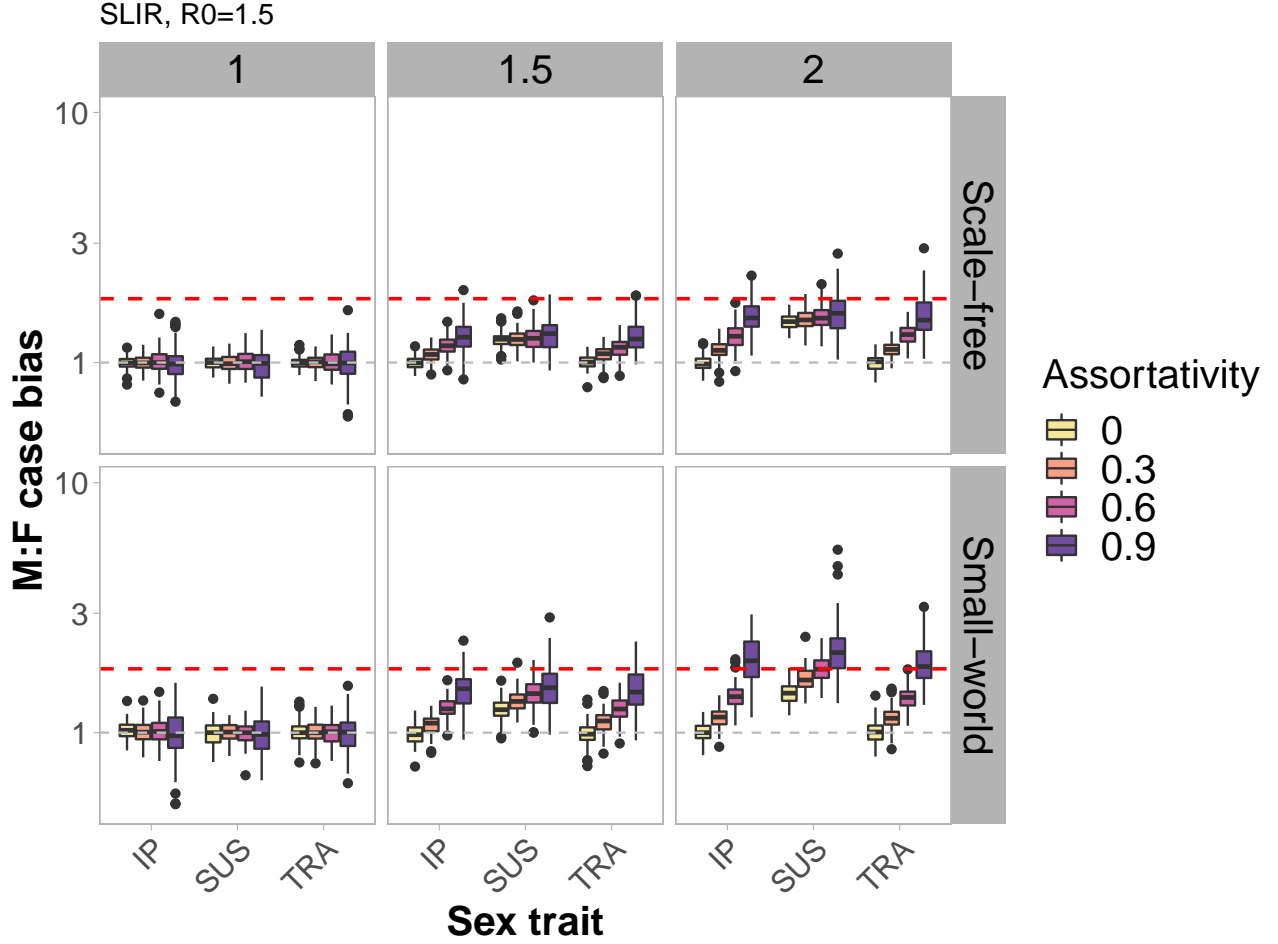
Figure 2: The effects of assortativity on male-bias in SLIR model. Vertical panels show sex-trait ratios (α) for sex-traits shown at the bottom including male:female infectious period (IP), susceptibility (SUS), and transmissibility (TRA). Hortizontal panels show different network types (scale-free and small-world). The red dashed line shows the observed ratio of male:female cases globally and the grey dashed line represents even distribution of cases between men and women. Results for $\tau = 0.075$ shown.

Take-aways for male-bias:

- Low transmissibility
- With endemic (SLIRS) dynamics
- Infectious period especially, and also susceptibility can lead to male bias
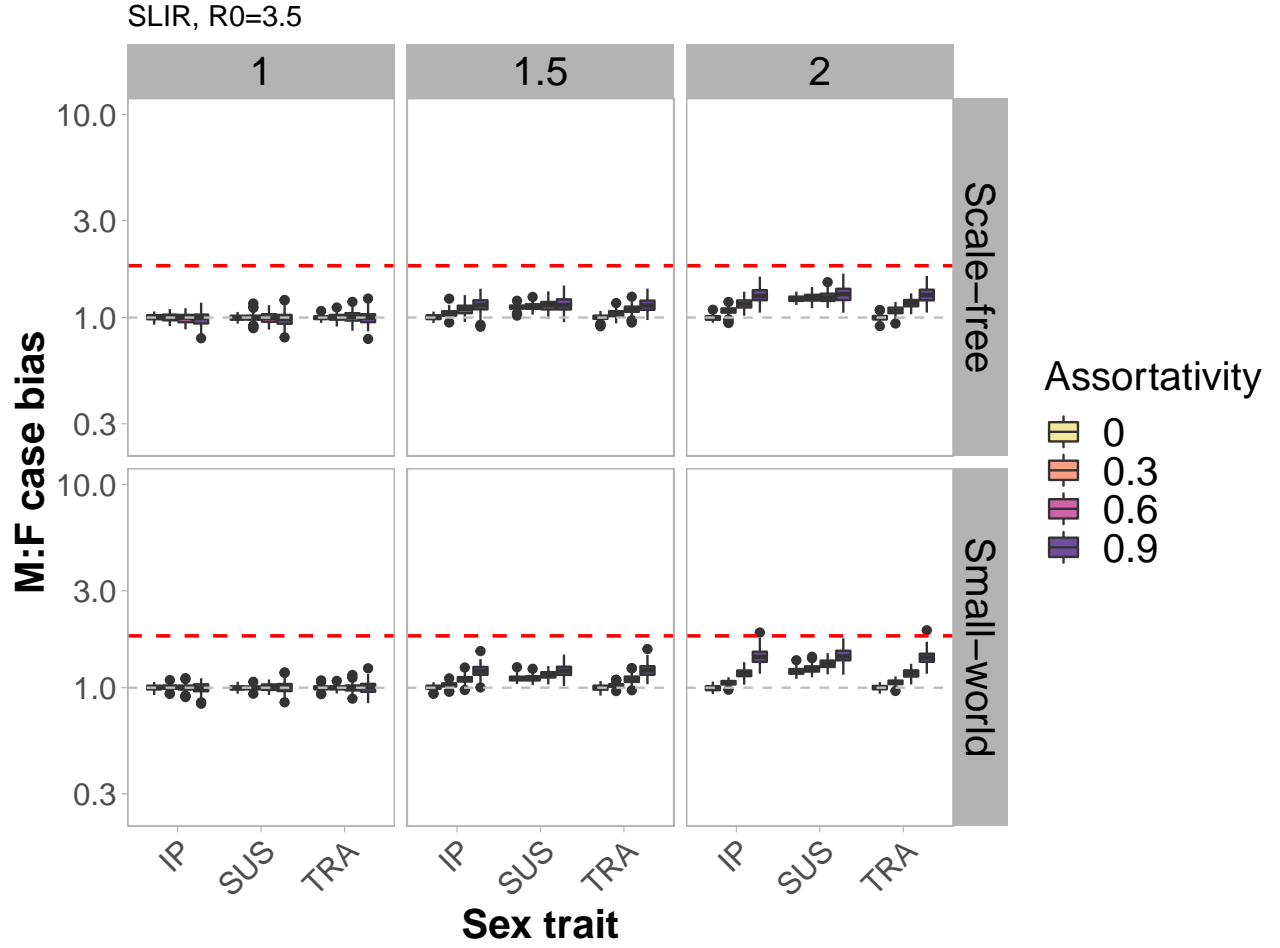- Interaction between sex-traits and assortativity on male-bias

Figure 3: The effects of assortativity on male-bias in SLIR model. Vertical panels show sex-trait ratios (α) for sex-traits shown at the bottom including male:female infectious period (IP), susceptibility (SUS), and transmissibility (TRA). Hortizontal panels show different network types (scale-free and small-world). The red dashed line shows the observed ratio of male:female cases globally and the grey dashed line represents even distribution of cases between men and women. Results for $\tau = 0.15$ shown.
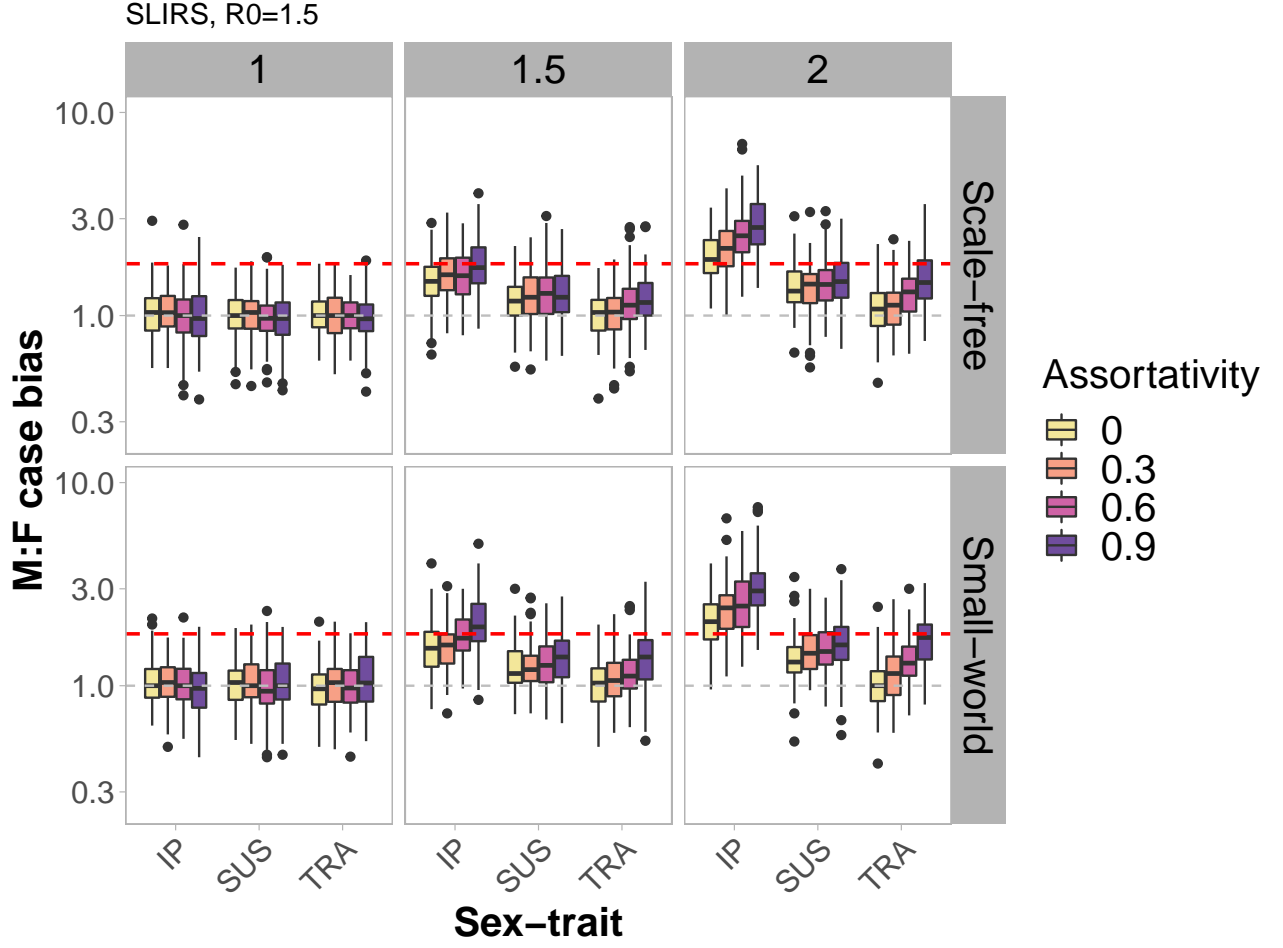
Figure 4: The effects of assortativity on male-bias in SLIRS model. Vertical panels show sex-trait ratios (α) for sex-traits shown at the bottom including male:female infectious period (IP), susceptibility (SUS), and transmissibility (TRA). Hortizontal panels show different network types (scale-free and small-world). The red dashed line shows the observed ratio of male:female cases globally and the grey dashed line represents even distribution of cases between men and women. Results for $\tau = 0.075$ shown.
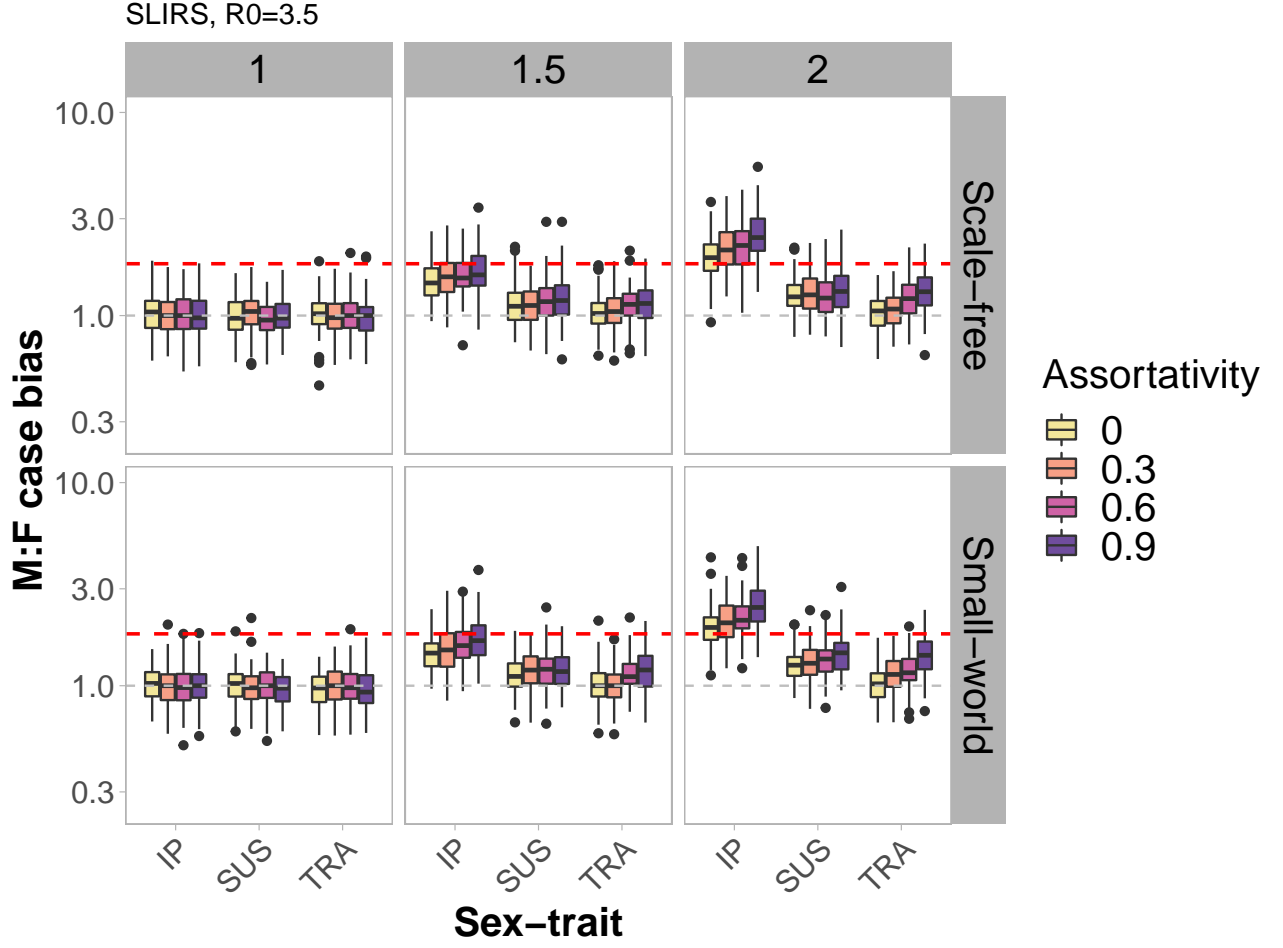
Figure 5: The effects of assortativity on male-bias in SLIRS model. Vertical panels show sex-trait ratios (α) for sex-traits shown at the bottom including male:female infectious period (IP), susceptibility (SUS), and transmissibility (TRA). Hortizontal panels show different network types (scale-free and small-world). The red dashed line shows the observed ratio of male:female cases globally and the grey dashed line represents even distribution of cases between men and women. Results for $\tau = 0.15$ shown.
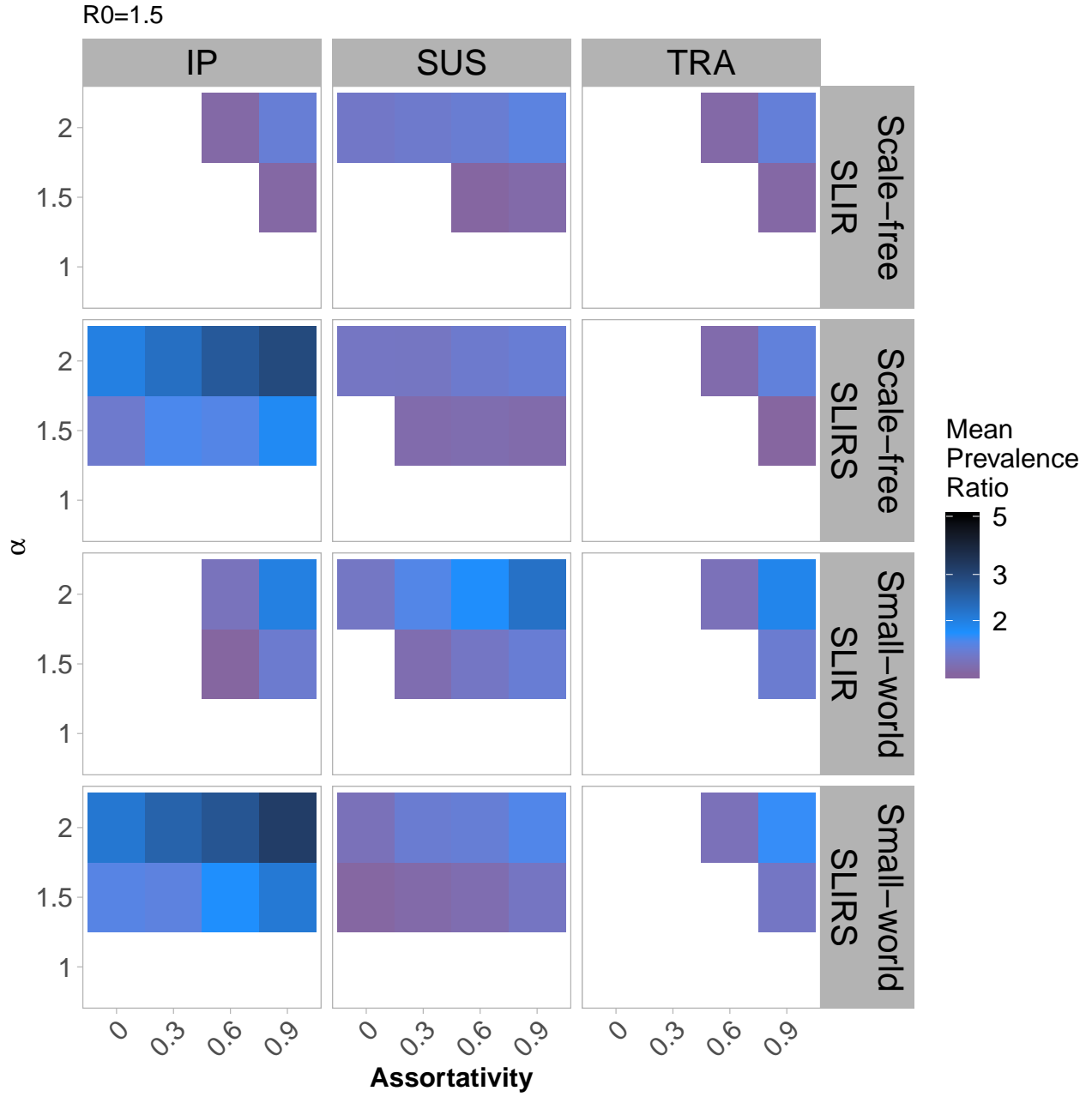
Figure 6: The combined effects of assortativity and individual-level variation on male-bias across different sex-traits and network types. Vertical panels show type of sex-traits: Infectious period (IP), Susceptibility (SUS), and Transmissibility (TRA). Horizontal panels show model types (SLIR and SLIRS) and network type (scale-free and small-world). Color shows mean value of male:female prevalence for that parameter combination (only values above 1.25 are shown). In general, higher male susceptibility can lead to some amount of male-bias, but for SLIRS models, longer male infectious periods is a striking driver of male-bias.
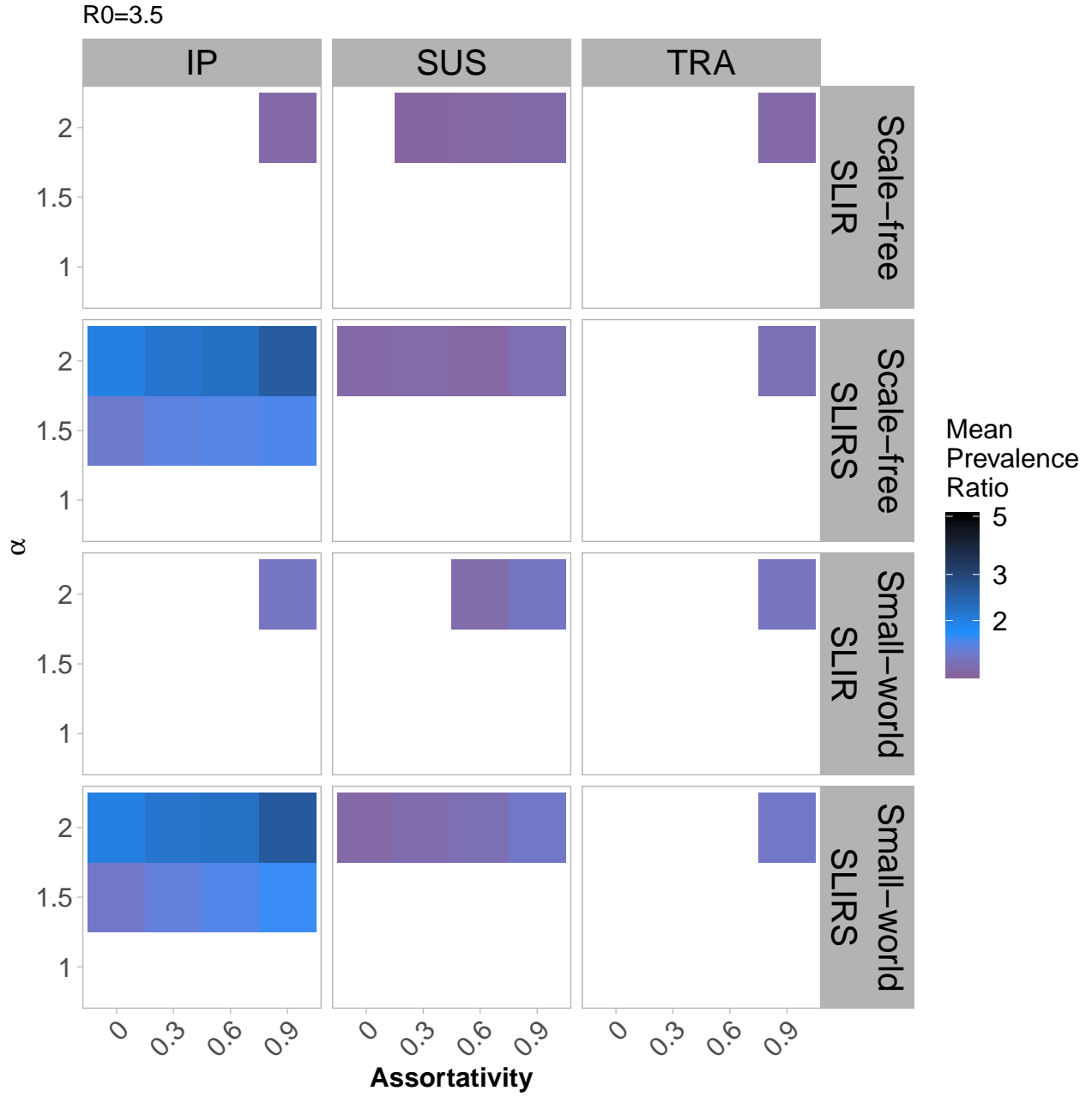
Figure 7: The combined effects of assortativity and individual-level variation on male-bias across different sex-traits and network types. Vertical panels show type of sex-traits: Infectious period (IP), Susceptibility (SUS), and Transmissibility (TRA). Horizontal panels show model types (SLIR and SLIRS) and network type (scale-free and small-world). Color shows mean value of male:female prevalence for that parameter combination (only values above 1.25 are shown). In general, higher male susceptibility can lead to some amount of male-bias, but for SLIRS models, longer male infectious periods is a striking driver of male-bias.
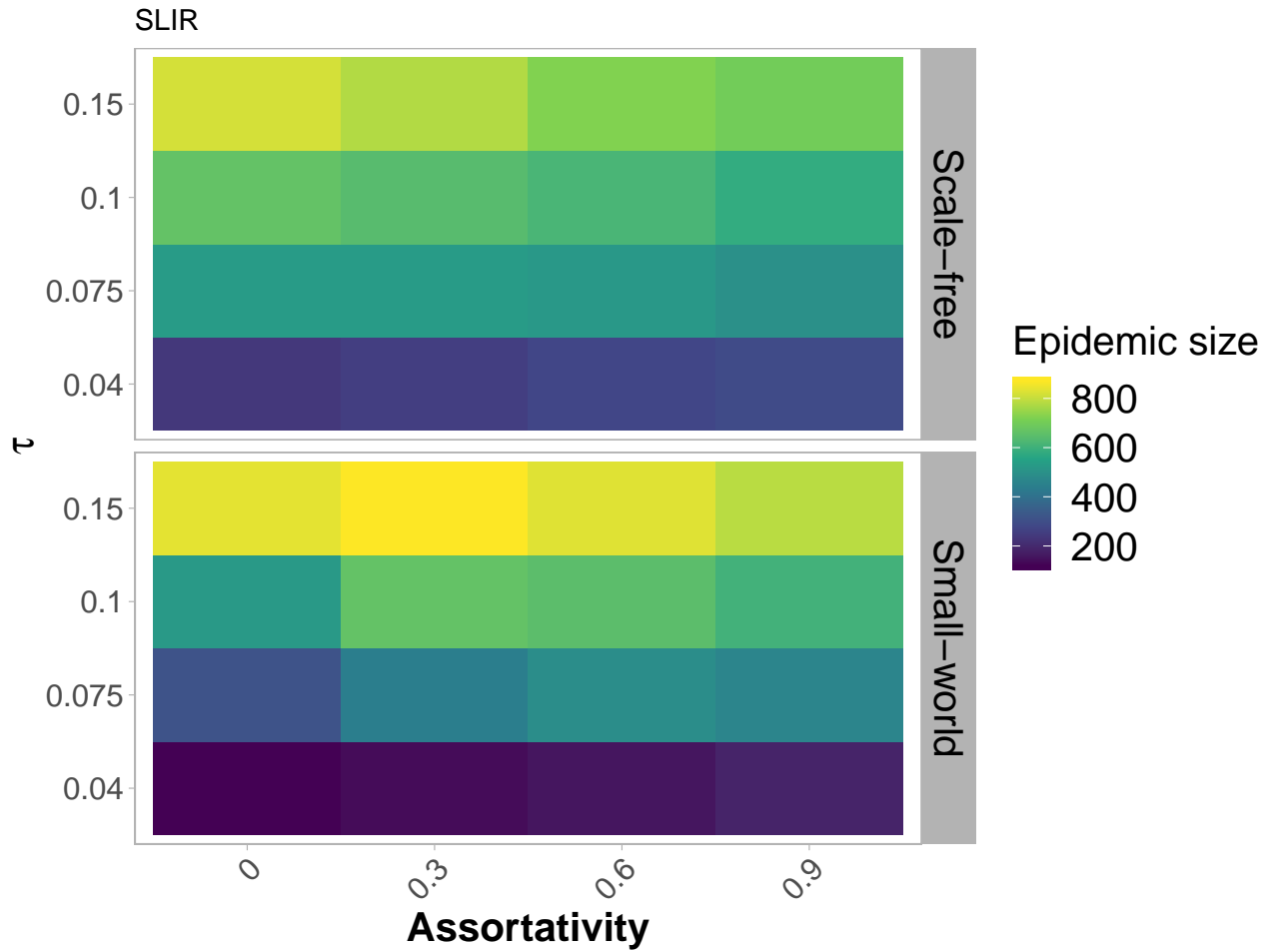
Figure 8: Effects of network structure on epidemic size in SLIR model. Hortizontal panels show different network types (scale-free and small-world).
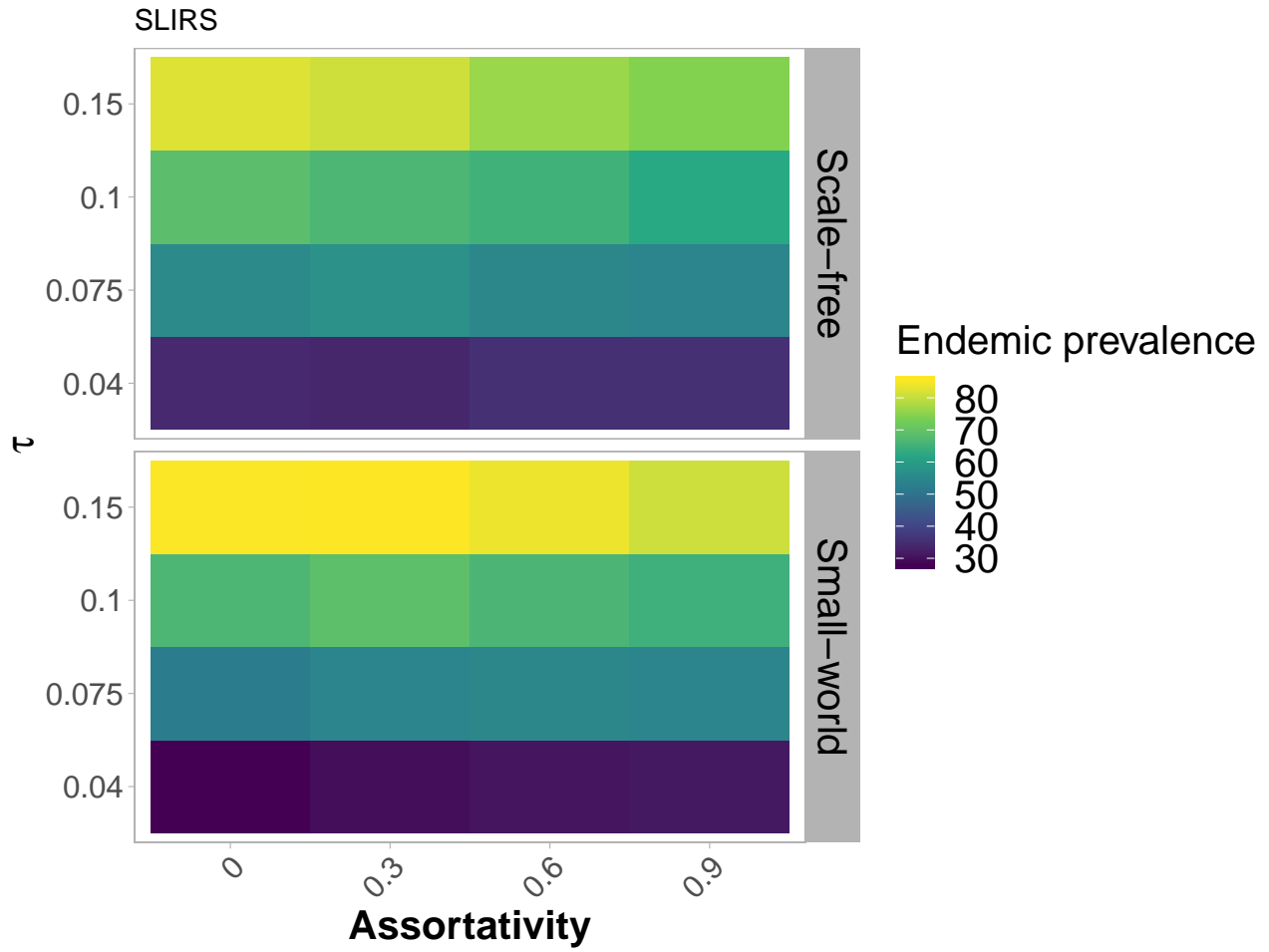
Figure 9: Effects of network structure on endemic prevalence in SLIRS model. Hortizontal panels show different network types (scale-free and small-world).