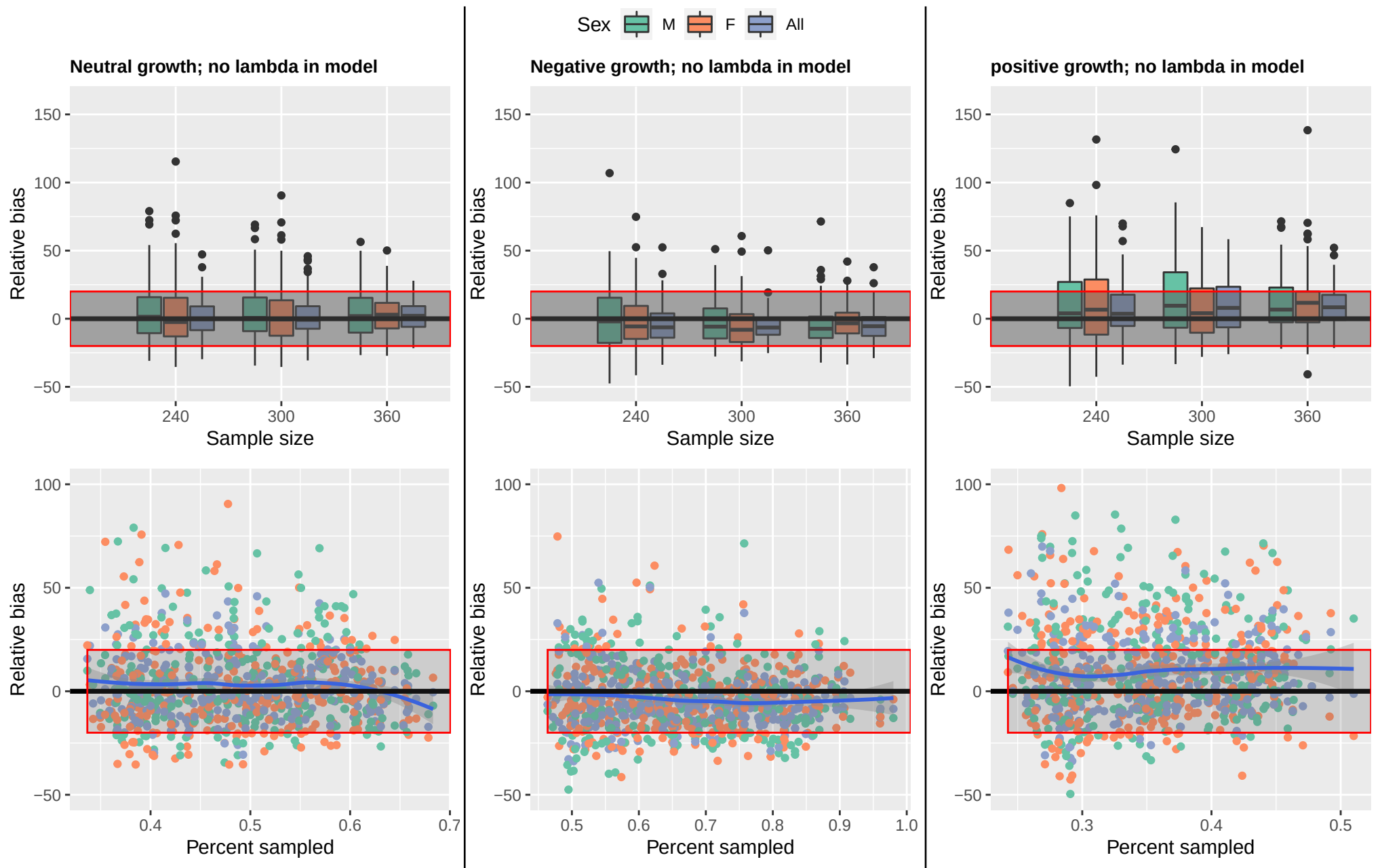
Results from a model that assumes constant abundance when the population is changing

Median relative bias for a model that assumes constant abundance when fit to populations with different amounts of population growth.

Top is neutral population growth: estimates are slightly positive and slightly negative.
Middle is negative population growth: estimates are negative because more kin-pairs were found in a shrinking population than expected.
Bottom is positive population growth: estimates are positive because fewer kin pairs were found in a growing population than expected.

```
> IBS.null_Lemon_neutral_growth.df %>% group_by(Sex, Total_samples) %>% summarize(median(Relative_bias)
`summarise()` regrouping output by 'Sex' (override with `.groups` argument)
# A tibble: 9 x 3
# Groups:   Sex [3]
  Sex   Total_samples `median(Relative_bias)`
  <fct>         <dbl>                   <dbl>
1 M               240                    1.45
2 M               300                    0.6
3 M               360                    1.95
4 F               240                   -2.4
5 F               300                   -0.55
6 F               360                    2.95
7 All             240                   -0.25
8 All             300                   -0.8
9 All             360                    2.15
> IBS.null_Lemon_negative_growth.df %>% group_by(Sex, Total_samples) %>% summarize(median(Relative_bias
`summarise()` regrouping output by 'Sex' (override with `.groups` argument)
# A tibble: 9 x 3
# Groups:   Sex [3]
  Sex   Total_samples `median(Relative_bias)`
  <fct>         <dbl>                   <dbl>
1 M               240                   -1.95
2 M               300                   -5.8
3 M               360                   -7.35
4 F               240                   -5.65
5 F               300                   -8.1
6 F               360                   -3.35
7 All             240                   -6.3
8 All             300                   -6.45
9 All             360                   -5.5
> IBS.null_Lemon_positive_growth.df %>% group_by(Sex, Total_samples) %>% summarize(median(Relative_bias
`summarise()` regrouping output by 'Sex' (override with `.groups` argument)
# A tibble: 9 x 3
# Groups:   Sex [3]
  Sex   Total_samples `median(Relative_bias)`
  <fct>         <dbl>                   <dbl>
1 M               240                    3.95
2 M               300                    9.55
3 M               360                    6.7
4 F               240                    6.65
5 F               300                    4.05
6 F               360                   11.7
7 All             240                    3.65
8 All             300                    7.95
9 All             360                    8.4
>
```

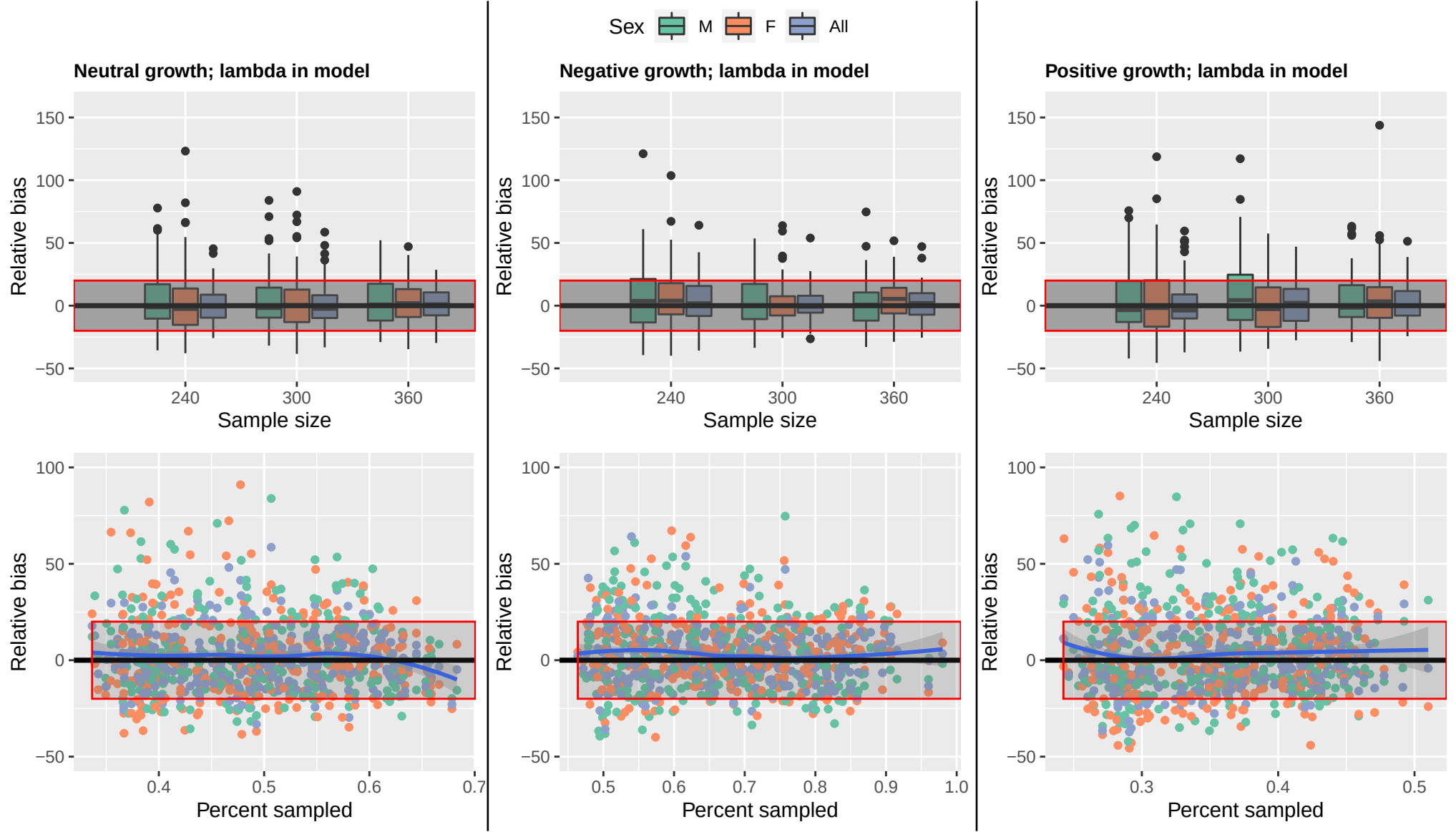

Sex
M
F
All
Neutral growth; no lambda in model
Negative growth; no lambda in model
positive growth; no lambda in model
Relative bias
Sample size
Percent sampled
150
100
50
0
−50
240
300
360
0.4
0.5
0.6
0.7
0.8
0.9
1.0
0.3

Results from a model that accounts for population growth by including a parameter for lambda. The model was fit to the same population as above.

Median relative bias for a model that includes lambda to account for a changing population size.

Top is neutral population growth: estimates are slightly positive and slightly negative as expected.
Middle is negative population growth: the persistent negative bias is now rectified.
Bottom is positive population growth: the persistent positive bias is now rectified.

```
`summarise()` regrouping output by 'Sex' (override with `.groups` argument)
# A tibble: 9 x 3
# Groups:   Sex [3]
  Sex   Total_samples `median(Relative_bias)`
  <fct>         <dbl>                   <dbl>
1 M               240                   -1.25
2 M               300                   -1.85
3 M               360                    0.85
4 F               240                   -2.6
5 F               300                    0.4
6 F               360                    1.9
7 All             240                   -0.8
8 All             300                   -2.45
9 All             360                    1
> IBS.null_Lemon_negative_growth_lambdaModel.df %>% group_by(Sex, Total_samples) %>% summarize(median(Rel
ative_bias))
`summarise()` regrouping output by 'Sex' (override with `.groups` argument)
# A tibble: 9 x 3
# Groups:   Sex [3]
  Sex   Total_samples `median(Relative_bias)`
  <fct>         <dbl>                   <dbl>
1 M               240                    3.75
2 M               300                    0.1
3 M               360                    0.7
4 F               240                    3.95
5 F               300                   -0.25
6 F               360                    5.4
7 All             240                    1.85
8 All             300                   -0.8
9 All             360                    2.05
> IBS.null_Lemon_positive_growth_lambdaModel.df %>% group_by(Sex, Total_samples) %>% summarize(median(Rel
ative_bias))
`summarise()` regrouping output by 'Sex' (override with `.groups` argument)
# A tibble: 9 x 3
# Groups:   Sex [3]
  Sex   Total_samples `median(Relative_bias)`
  <fct>         <dbl>                   <dbl>
1 M               240                   -3.7
2 M               300                    4.35
3 M               360                   -1.6
4 F               240                   -1.9
5 F               300                   -2.75
6 F               360                    3.4
7 All             240                   -3.8
8 All             300                    2.2
9 All             360                    0.2
>
```


Sex
M
F
All
Neutral growth; lambda in model
Negative growth; lambda in model
Positive growth; lambda in model
Relative bias
150
100
50
0
−50
240
300
360
Sample size
100
50
0
−50
0.4
0.5
0.6
0.7
0.5
0.6
0.7
0.8
0.9
1.0
0.3
0.4
0.5
Percent sampled