

# COVID-19 Baseline Risk Score Analysis Report

mock Study

USG COVID-19 Response Biostatistics Team

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## Chapter 1

# Baseline Risk Score (Proxy for SARS-CoV-2 Exposure)

Table 1.1: Variables considered for risk score analysis.

| Variable.Name        | Definition   | Total.missing.values | Comments |
|----------------------|--|----------------------|----------|
| MinorityInd          | Baseline covariate underrepresented minority status (1=minority, 0=non-minority) | 0/30000 (0.0%)       | NA       |
| EthnicityHispanic    | Indicator ethnicity = Hispanic (0 = Non-Hispanic)                                | 0/30000 (0.0%)       | NA       |
| EthnicityNotreported | Indicator ethnicity = Not reported (0 = Non-Hispanic)                            | 0/30000 (0.0%)       | NA       |
| EthnicityUnknown     | Indicator ethnicity = Unknown (0 = Non-Hispanic)                                 | 0/30000 (0.0%)       | NA       |
| Black                | Indicator race = Black (0 = White)   | 0/30000 (0.0%)       | NA       |
| Asian                | Indicator race = Asian (0 = White)   | 0/30000 (0.0%)       | NA       |
| NatAmer              | Indicator race = American Indian or Alaska Native (0 = White)                    | 0/30000 (0.0%)       | NA       |
| PacIsl               | Indicator race = Native Hawaiian or Other Pacific Islander (0 = White)           | 0/30000 (0.0%)       | NA       |
| Multiracial          | Indicator race = Multiracial (0 = White)   | 0/30000 (0.0%)       | NA       |
| Other                | Indicator race = Other (0 = White)   | 0/30000 (0.0%)       | NA       |
| Notreported          | Indicator race = Not reported (0 = White)  | 0/30000 (0.0%)       | NA       |
| Unknown              | Indicator race = unknown (0 = White)   | 0/30000 (0.0%)       | NA       |
| HighRiskInd          | Baseline covariate high risk pre-existing condition (1=yes, 0=no)                | 0/30000 (0.0%)       | NA       |
| Sex                  | Sex assigned at birth (1=female, 0=male)   | 0/30000 (0.0%)       | NA       |
| Age                  | Age at enrollment in years, between 18 and 85                                    | 0/30000 (0.0%)       | NA       |
| BMI                  | BMI at enrollment ( $\text{kg}/\text{m}^2$ )                                     | 0/30000 (0.0%)       | NA       |

Table 1.2: All learner-screen combinations (28 in total) used as input to the Superlearner.

| <b>Learner</b>     | <b>Screen*</b>  |
|--------------------|---|
| SL.mean            | all   |
| SL.glm             | all<br>glmnet<br>univar_logistic_pval<br>highcor_random |
| SL.glm.interaction | glmnet<br>univar_logistic_pval<br>highcor_random        |
| SL.glmnet          | all   |
| SL.gam             | glmnet<br>univar_logistic_pval<br>highcor_random        |
| SL.xgboost         | all   |
| SL.ranger.imp      | all   |

*Note:*

\*Screen details:

all: includes all variables

glmnet: includes variables with non-zero coefficients in the standard implementation of SL.glmnet that optimizes the lasso tuning parameter via cross-validation

univar\_logistic\_pval: Wald test 2-sided p-value in a logistic regression model  $< 0.10$

highcor\_random: if pairs of quantitative variables with Spearman rank correlation  $> 0.90$ , select one of the variables at random

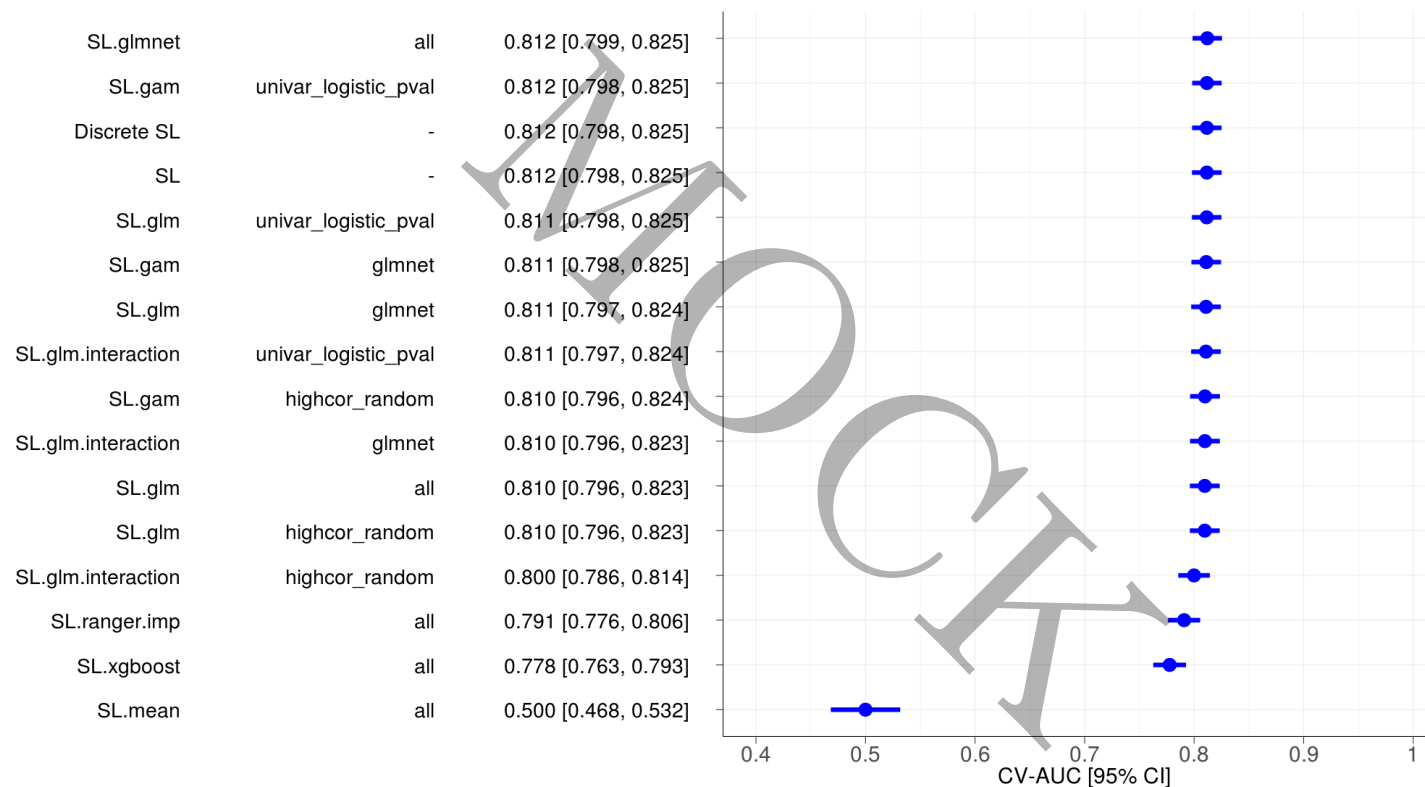


Figure 1.1: Cross-validated AUC (95% CI) of algorithms for predicting COVID-19 disease status starting 7 days after Day 57.

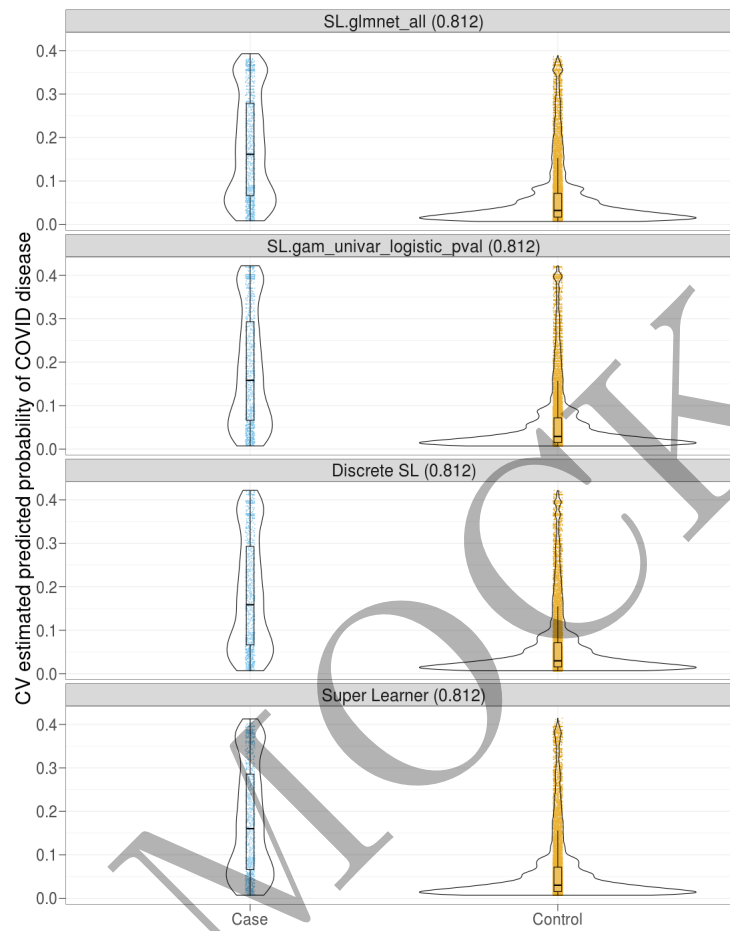


Figure 1.2: CV-estimated predicted probabilities of COVID-19 disease 7 days after Day 57 by case/control status for top 2 learners, SuperLearner and Discrete SL.

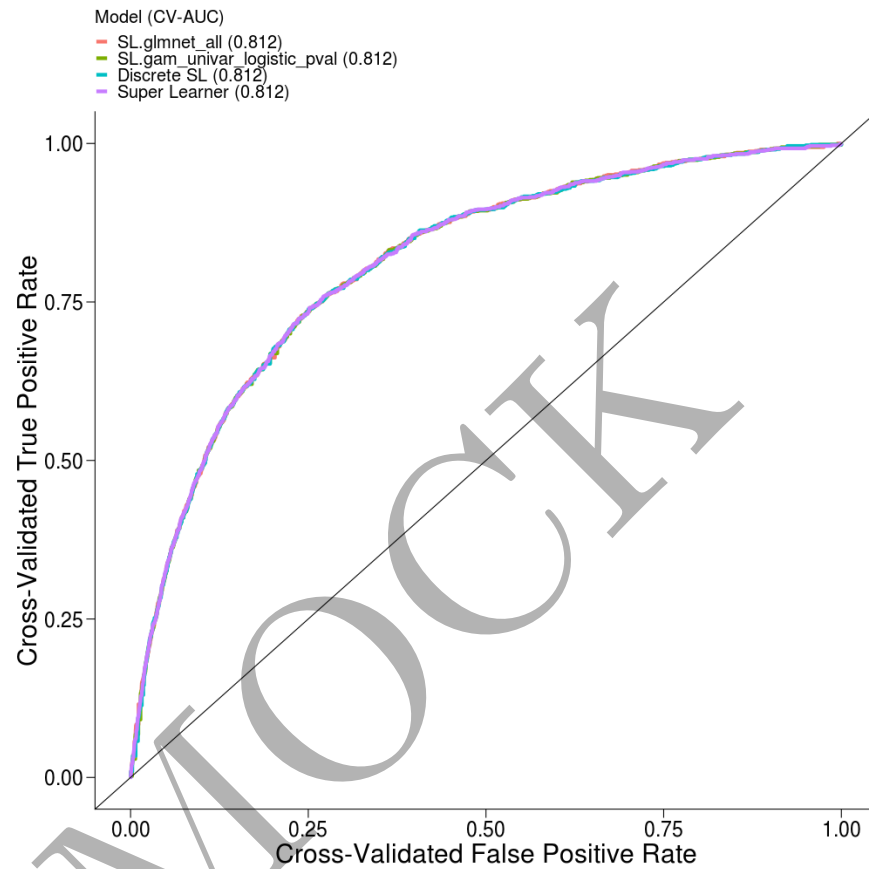


Figure 1.3: ROC curves based off CV-estimated predicted probabilities for the top 2 learners, Superlearner and Discrete SL.

Table 1.3: Weights assigned by Superlearner.

| Learner            | Screen                          | Weight |
|--------------------|---------------------------------|--------|
| SL.gam             | screen_univariate_logistic_pval | 0.531  |
| SL.glmnet          | screen_all                      | 0.444  |
| SL.glm.interaction | screen_highcor_random           | 0.025  |
| SL.mean            | screen_all                      | 0.000  |
| SL.glm             | screen_all                      | 0.000  |
| SL.xgboost         | screen_all                      | 0.000  |
| SL.ranger.imp      | screen_all                      | 0.000  |
| SL.glm             | screen_glmnet                   | 0.000  |
| SL.glm             | screen_univariate_logistic_pval | 0.000  |
| SL.glm             | screen_highcor_random           | 0.000  |
| SL.glm.interaction | screen_glmnet                   | 0.000  |
| SL.glm.interaction | screen_univariate_logistic_pval | 0.000  |
| SL.gam             | screen_glmnet                   | 0.000  |
| SL.gam             | screen_highcor_random           | 0.000  |

Table 1.4: Predictors in learners assigned weight &gt; 0.0 by Superlearner.

| Learner            | Screen                          | Weight | Predictors                       | Coefficient | Odds.Ratio |
|--------------------|---------------------------------|--------|----------------------------------|-------------|------------|
| SL.gam             | screen_univariate_logistic_pval | 0.531  | (Intercept)                      | -3.202      | 0.041      |
| SL.gam             | screen_univariate_logistic_pval | 0.531  | s(Age,2)                         | 0.743       | 2.103      |
| SL.gam             | screen_univariate_logistic_pval | 0.531  | HighRiskInd                      | 0.842       | 2.322      |
| SL.glmnet          | screen_all                      | 0.444  | (Intercept)                      | -2.881      | 0.056      |
| SL.glmnet          | screen_all                      | 0.444  | MinorityInd                      | 0.000       | 1.000      |
| SL.glmnet          | screen_all                      | 0.444  | EthnicityHispanic                | 0.000       | 1.000      |
| SL.glmnet          | screen_all                      | 0.444  | EthnicityNotreported             | 0.000       | 1.000      |
| SL.glmnet          | screen_all                      | 0.444  | EthnicityUnknown                 | 0.000       | 1.000      |
| SL.glmnet          | screen_all                      | 0.444  | Black                            | 0.000       | 1.000      |
| SL.glmnet          | screen_all                      | 0.444  | Asian                            | 0.000       | 1.000      |
| SL.glmnet          | screen_all                      | 0.444  | NatAmer                          | 0.000       | 1.000      |
| SL.glmnet          | screen_all                      | 0.444  | PacIsl                           | 0.000       | 1.000      |
| SL.glmnet          | screen_all                      | 0.444  | Multiracial                      | 0.000       | 1.000      |
| SL.glmnet          | screen_all                      | 0.444  | Other                            | 0.000       | 1.000      |
| SL.glmnet          | screen_all                      | 0.444  | Notreported                      | 0.000       | 1.000      |
| SL.glmnet          | screen_all                      | 0.444  | Unknown                          | 0.000       | 1.000      |
| SL.glmnet          | screen_all                      | 0.444  | HighRiskInd                      | 0.624       | 1.867      |
| SL.glmnet          | screen_all                      | 0.444  | Sex                              | 0.000       | 1.000      |
| SL.glmnet          | screen_all                      | 0.444  | Age                              | 0.444       | 1.560      |
| SL.glmnet          | screen_all                      | 0.444  | BMI                              | 0.000       | 1.000      |
| SL.glm.interaction | screen_highcor_random           | 0.025  | (Intercept)                      | -3.388      | 0.034      |
| SL.glm.interaction | screen_highcor_random           | 0.025  | MinorityInd                      | -0.267      | 0.765      |
| SL.glm.interaction | screen_highcor_random           | 0.025  | EthnicityHispanic                | -0.022      | 0.978      |
| SL.glm.interaction | screen_highcor_random           | 0.025  | EthnicityNotreported             | -0.401      | 0.670      |
| SL.glm.interaction | screen_highcor_random           | 0.025  | EthnicityUnknown                 | -0.090      | 0.914      |
| SL.glm.interaction | screen_highcor_random           | 0.025  | Black                            | 0.254       | 1.289      |
| SL.glm.interaction | screen_highcor_random           | 0.025  | Asian                            | 0.060       | 1.061      |
| SL.glm.interaction | screen_highcor_random           | 0.025  | NatAmer                          | -0.012      | 0.988      |
| SL.glm.interaction | screen_highcor_random           | 0.025  | PacIsl                           | -0.085      | 0.918      |
| SL.glm.interaction | screen_highcor_random           | 0.025  | Multiracial                      | -0.117      | 0.889      |
| SL.glm.interaction | screen_highcor_random           | 0.025  | Other                            | -0.073      | 0.929      |
| SL.glm.interaction | screen_highcor_random           | 0.025  | Notreported                      | 0.018       | 1.018      |
| SL.glm.interaction | screen_highcor_random           | 0.025  | Unknown                          | -0.073      | 0.929      |
| SL.glm.interaction | screen_highcor_random           | 0.025  | HighRiskInd                      | 0.880       | 2.412      |
| SL.glm.interaction | screen_highcor_random           | 0.025  | Sex                              | 0.069       | 1.071      |
| SL.glm.interaction | screen_highcor_random           | 0.025  | Age                              | 0.806       | 2.239      |
| SL.glm.interaction | screen_highcor_random           | 0.025  | BMI                              | -0.024      | 0.976      |
| SL.glm.interaction | screen_highcor_random           | 0.025  | MinorityInd:EthnicityHispanic    | NA          | NA         |
| SL.glm.interaction | screen_highcor_random           | 0.025  | MinorityInd:EthnicityNotreported | -1.351      | 0.259      |
| SL.glm.interaction | screen_highcor_random           | 0.025  | MinorityInd:EthnicityUnknown     | 0.106       | 1.112      |
| SL.glm.interaction | screen_highcor_random           | 0.025  | MinorityInd:Black                | NA          | NA         |
| SL.glm.interaction | screen_highcor_random           | 0.025  | MinorityInd:Asian                | NA          | NA         |
| SL.glm.interaction | screen_highcor_random           | 0.025  | MinorityInd:NatAmer              | NA          | NA         |
| SL.glm.interaction | screen_highcor_random           | 0.025  | MinorityInd:PacIsl               | NA          | NA         |
| SL.glm.interaction | screen_highcor_random           | 0.025  | MinorityInd:Multiracial          | NA          | NA         |



Table 1.4: Predictors in learners assigned weight &gt; 0.0 by Superlearner. (continued)

| Learner            | Screen                | Weight | Predictors                             | Coefficient | Odds.Ratio |
|--------------------|-----------------------|--------|--|-------------|------------|
| SL.glm.interaction | screen_highcor_random | 0.025  | MinorityInd:Other                      | NA          | NA         |
| SL.glm.interaction | screen_highcor_random | 0.025  | MinorityInd:Notreported                | 0.054       | 1.055      |
| SL.glm.interaction | screen_highcor_random | 0.025  | MinorityInd:Unknown                    | 0.045       | 1.046      |
| SL.glm.interaction | screen_highcor_random | 0.025  | MinorityInd:HighRiskInd                | 0.196       | 1.217      |
| SL.glm.interaction | screen_highcor_random | 0.025  | MinorityInd:Sex                        | 0.181       | 1.199      |
| SL.glm.interaction | screen_highcor_random | 0.025  | MinorityInd:Age                        | -0.201      | 0.818      |
| SL.glm.interaction | screen_highcor_random | 0.025  | MinorityInd:BMI                        | 0.087       | 1.091      |
| SL.glm.interaction | screen_highcor_random | 0.025  | EthnicityHispanic:EthnicityNotreported | NA          | NA         |
| SL.glm.interaction | screen_highcor_random | 0.025  | EthnicityHispanic:EthnicityUnknown     | NA          | NA         |
| SL.glm.interaction | screen_highcor_random | 0.025  | EthnicityHispanic:Black                | -0.018      | 0.982      |
| SL.glm.interaction | screen_highcor_random | 0.025  | EthnicityHispanic:Asian                | -0.096      | 0.908      |
| SL.glm.interaction | screen_highcor_random | 0.025  | EthnicityHispanic:NatAmer              | 0.028       | 1.029      |
| SL.glm.interaction | screen_highcor_random | 0.025  | EthnicityHispanic:PacIsl               | 0.279       | 1.321      |
| SL.glm.interaction | screen_highcor_random | 0.025  | EthnicityHispanic:Multiracial          | 0.049       | 1.050      |
| SL.glm.interaction | screen_highcor_random | 0.025  | EthnicityHispanic:Other                | NA          | NA         |
| SL.glm.interaction | screen_highcor_random | 0.025  | EthnicityHispanic:Notreported          | NA          | NA         |
| SL.glm.interaction | screen_highcor_random | 0.025  | EthnicityHispanic:Unknown              | NA          | NA         |
| SL.glm.interaction | screen_highcor_random | 0.025  | EthnicityHispanic:HighRiskInd          | -0.081      | 0.923      |
| SL.glm.interaction | screen_highcor_random | 0.025  | EthnicityHispanic:Sex                  | -0.073      | 0.929      |
| SL.glm.interaction | screen_highcor_random | 0.025  | EthnicityHispanic:Age                  | 0.118       | 1.125      |
| SL.glm.interaction | screen_highcor_random | 0.025  | EthnicityHispanic:BMI                  | -0.085      | 0.919      |
| SL.glm.interaction | screen_highcor_random | 0.025  | EthnicityNotreported:EthnicityUnknown  | NA          | NA         |
| SL.glm.interaction | screen_highcor_random | 0.025  | EthnicityNotreported:Black             | 0.972       | 2.643      |
| SL.glm.interaction | screen_highcor_random | 0.025  | EthnicityNotreported:Asian             | 0.643       | 1.902      |
| SL.glm.interaction | screen_highcor_random | 0.025  | EthnicityNotreported:NatAmer           | -0.011      | 0.989      |
| SL.glm.interaction | screen_highcor_random | 0.025  | EthnicityNotreported:PacIsl            | 0.369       | 1.446      |
| SL.glm.interaction | screen_highcor_random | 0.025  | EthnicityNotreported:Multiracial       | 0.046       | 1.047      |
| SL.glm.interaction | screen_highcor_random | 0.025  | EthnicityNotreported:Other             | NA          | NA         |
| SL.glm.interaction | screen_highcor_random | 0.025  | EthnicityNotreported:Notreported       | 0.000       | 1.000      |
| SL.glm.interaction | screen_highcor_random | 0.025  | EthnicityNotreported:Unknown           | 0.023       | 1.024      |
| SL.glm.interaction | screen_highcor_random | 0.025  | EthnicityNotreported:HighRiskInd       | 0.035       | 1.035      |
| SL.glm.interaction | screen_highcor_random | 0.025  | EthnicityNotreported:Sex               | -0.117      | 0.889      |
| SL.glm.interaction | screen_highcor_random | 0.025  | EthnicityNotreported:Age               | 0.011       | 1.011      |
| SL.glm.interaction | screen_highcor_random | 0.025  | EthnicityNotreported:BMI               | -0.020      | 0.981      |
| SL.glm.interaction | screen_highcor_random | 0.025  | EthnicityUnknown:Black                 | -0.059      | 0.942      |
| SL.glm.interaction | screen_highcor_random | 0.025  | EthnicityUnknown:Asian                 | -0.075      | 0.928      |
| SL.glm.interaction | screen_highcor_random | 0.025  | EthnicityUnknown:NatAmer               | -0.026      | 0.974      |
| SL.glm.interaction | screen_highcor_random | 0.025  | EthnicityUnknown:PacIsl                | -0.309      | 0.734      |
| SL.glm.interaction | screen_highcor_random | 0.025  | EthnicityUnknown:Multiracial           | -0.013      | 0.987      |
| SL.glm.interaction | screen_highcor_random | 0.025  | EthnicityUnknown:Other                 | NA          | NA         |
| SL.glm.interaction | screen_highcor_random | 0.025  | EthnicityUnknown:Notreported           | 0.008       | 1.008      |
| SL.glm.interaction | screen_highcor_random | 0.025  | EthnicityUnknown:Unknown               | 0.029       | 1.029      |
| SL.glm.interaction | screen_highcor_random | 0.025  | EthnicityUnknown:HighRiskInd           | 0.044       | 1.045      |
| SL.glm.interaction | screen_highcor_random | 0.025  | EthnicityUnknown:Sex                   | -0.010      | 0.990      |
| SL.glm.interaction | screen_highcor_random | 0.025  | EthnicityUnknown:Age                   | 0.009       | 1.009      |

Table 1.4: Predictors in learners assigned weight  $> 0.0$  by Superlearner. (continued)

| Learner            | Screen                | Weight | Predictors              | Coefficient | Odds.Ratio |
|--------------------|-----------------------|--------|-------------------------|-------------|------------|
| SL.glm.interaction | screen_highcor_random | 0.025  | EthnicityUnknown:BMI    | -0.106      | 0.900      |
| SL.glm.interaction | screen_highcor_random | 0.025  | Black:Asian             | NA          | NA         |
| SL.glm.interaction | screen_highcor_random | 0.025  | Black:NatAmer           | NA          | NA         |
| SL.glm.interaction | screen_highcor_random | 0.025  | Black:PacIsl            | NA          | NA         |
| SL.glm.interaction | screen_highcor_random | 0.025  | Black:Multiracial       | NA          | NA         |
| SL.glm.interaction | screen_highcor_random | 0.025  | Black:Other             | NA          | NA         |
| SL.glm.interaction | screen_highcor_random | 0.025  | Black:Notreported       | NA          | NA         |
| SL.glm.interaction | screen_highcor_random | 0.025  | Black:Unknown           | NA          | NA         |
| SL.glm.interaction | screen_highcor_random | 0.025  | Black:HighRiskInd       | -0.183      | 0.832      |
| SL.glm.interaction | screen_highcor_random | 0.025  | Black:Sex               | -0.132      | 0.876      |
| SL.glm.interaction | screen_highcor_random | 0.025  | Black:Age               | 0.181       | 1.199      |
| SL.glm.interaction | screen_highcor_random | 0.025  | Black:BMI               | -0.058      | 0.944      |
| SL.glm.interaction | screen_highcor_random | 0.025  | Asian:NatAmer           | NA          | NA         |
| SL.glm.interaction | screen_highcor_random | 0.025  | Asian:PacIsl            | NA          | NA         |
| SL.glm.interaction | screen_highcor_random | 0.025  | Asian:Multiracial       | NA          | NA         |
| SL.glm.interaction | screen_highcor_random | 0.025  | Asian:Other             | NA          | NA         |
| SL.glm.interaction | screen_highcor_random | 0.025  | Asian:Notreported       | NA          | NA         |
| SL.glm.interaction | screen_highcor_random | 0.025  | Asian:Unknown           | NA          | NA         |
| SL.glm.interaction | screen_highcor_random | 0.025  | Asian:HighRiskInd       | -0.061      | 0.941      |
| SL.glm.interaction | screen_highcor_random | 0.025  | Asian:Sex               | -0.104      | 0.901      |
| SL.glm.interaction | screen_highcor_random | 0.025  | Asian:Age               | 0.153       | 1.165      |
| SL.glm.interaction | screen_highcor_random | 0.025  | Asian:BMI               | -0.078      | 0.925      |
| SL.glm.interaction | screen_highcor_random | 0.025  | NatAmer:PacIsl          | NA          | NA         |
| SL.glm.interaction | screen_highcor_random | 0.025  | NatAmer:Multiracial     | NA          | NA         |
| SL.glm.interaction | screen_highcor_random | 0.025  | NatAmer:Other           | NA          | NA         |
| SL.glm.interaction | screen_highcor_random | 0.025  | NatAmer:Notreported     | NA          | NA         |
| SL.glm.interaction | screen_highcor_random | 0.025  | NatAmer:Unknown         | NA          | NA         |
| SL.glm.interaction | screen_highcor_random | 0.025  | NatAmer:HighRiskInd     | -0.086      | 0.918      |
| SL.glm.interaction | screen_highcor_random | 0.025  | NatAmer:Sex             | -0.097      | 0.907      |
| SL.glm.interaction | screen_highcor_random | 0.025  | NatAmer:Age             | -0.011      | 0.989      |
| SL.glm.interaction | screen_highcor_random | 0.025  | NatAmer:BMI             | -0.060      | 0.941      |
| SL.glm.interaction | screen_highcor_random | 0.025  | PacIsl:Multiracial      | NA          | NA         |
| SL.glm.interaction | screen_highcor_random | 0.025  | PacIsl:Other            | NA          | NA         |
| SL.glm.interaction | screen_highcor_random | 0.025  | PacIsl:Notreported      | NA          | NA         |
| SL.glm.interaction | screen_highcor_random | 0.025  | PacIsl:Unknown          | NA          | NA         |
| SL.glm.interaction | screen_highcor_random | 0.025  | PacIsl:HighRiskInd      | -0.052      | 0.949      |
| SL.glm.interaction | screen_highcor_random | 0.025  | PacIsl:Sex              | -0.098      | 0.907      |
| SL.glm.interaction | screen_highcor_random | 0.025  | PacIsl:Age              | 0.221       | 1.247      |
| SL.glm.interaction | screen_highcor_random | 0.025  | PacIsl:BMI              | -0.011      | 0.989      |
| SL.glm.interaction | screen_highcor_random | 0.025  | Multiracial:Other       | NA          | NA         |
| SL.glm.interaction | screen_highcor_random | 0.025  | Multiracial:Notreported | NA          | NA         |
| SL.glm.interaction | screen_highcor_random | 0.025  | Multiracial:Unknown     | NA          | NA         |
| SL.glm.interaction | screen_highcor_random | 0.025  | Multiracial:HighRiskInd | -0.053      | 0.948      |
| SL.glm.interaction | screen_highcor_random | 0.025  | Multiracial:Sex         | -0.051      | 0.950      |
| SL.glm.interaction | screen_highcor_random | 0.025  | Multiracial:Age         | 0.006       | 1.006      |

Table 1.4: Predictors in learners assigned weight &gt; 0.0 by Superlearner. (continued)

| Learner            | Screen                | Weight | Predictors                       | Coefficient | Odds.Ratio |
|--------------------|-----------------------|--------|----------------------------------|-------------|------------|
| SL.glm.interaction | screen_highcor_random | 0.025  | Multiracial:BMI                  | -0.077      | 0.926      |
| SL.glm.interaction | screen_highcor_random | 0.025  | Other:Notreported                | NA          | NA         |
| SL.glm.interaction | screen_highcor_random | 0.025  | Other:Unknown                    | NA          | NA         |
| SL.glm.interaction | screen_highcor_random | 0.025  | Other:HighRiskInd                | -0.007      | 0.993      |
| SL.glm.interaction | screen_highcor_random | 0.025  | Other:Sex                        | -0.008      | 0.992      |
| SL.glm.interaction | screen_highcor_random | 0.025  | Other:Age                        | 0.027       | 1.027      |
| SL.glm.interaction | screen_highcor_random | 0.025  | Other:BMI                        | -0.066      | 0.936      |
| SL.glm.interaction | screen_highcor_random | 0.025  | Notreported:Unknown              | NA          | NA         |
| SL.glm.interaction | screen_highcor_random | 0.025  | Notreported:HighRiskInd          | 0.021       | 1.021      |
| SL.glm.interaction | screen_highcor_random | 0.025  | Notreported:Sex                  | -0.043      | 0.958      |
| SL.glm.interaction | screen_highcor_random | 0.025  | Notreported:Age                  | 0.009       | 1.009      |
| SL.glm.interaction | screen_highcor_random | 0.025  | Notreported:BMI                  | -0.004      | 0.996      |
| SL.glm.interaction | screen_highcor_random | 0.025  | Unknown:HighRiskInd              | 0.051       | 1.052      |
| SL.glm.interaction | screen_highcor_random | 0.025  | Unknown:Sex                      | -0.058      | 0.944      |
| SL.glm.interaction | screen_highcor_random | 0.025  | Unknown:Age                      | 0.027       | 1.028      |
| SL.glm.interaction | screen_highcor_random | 0.025  | Unknown:BMI                      | 0.010       | 1.010      |
| SL.glm.interaction | screen_highcor_random | 0.025  | HighRiskInd:Sex                  | 0.002       | 1.002      |
| SL.glm.interaction | screen_highcor_random | 0.025  | HighRiskInd:Age                  | -0.045      | 0.956      |
| SL.glm.interaction | screen_highcor_random | 0.025  | HighRiskInd:BMI                  | -0.017      | 0.983      |
| SL.glm.interaction | screen_highcor_random | 0.025  | Sex:Age                          | -0.026      | 0.974      |
| SL.glm.interaction | screen_highcor_random | 0.025  | Sex:BMI                          | -0.012      | 0.988      |
| SL.glm.interaction | screen_highcor_random | 0.025  | Age:BMI                          | -0.007      | 0.993      |
| SL.glm.interaction | screen_highcor_random | 0.025  | (Intercept)                      | -3.388      | 0.034      |
| SL.glm.interaction | screen_highcor_random | 0.025  | MinorityInd                      | -0.267      | 0.765      |
| SL.glm.interaction | screen_highcor_random | 0.025  | EthnicityHispanic                | -0.022      | 0.978      |
| SL.glm.interaction | screen_highcor_random | 0.025  | EthnicityNotreported             | -0.401      | 0.670      |
| SL.glm.interaction | screen_highcor_random | 0.025  | EthnicityUnknown                 | -0.090      | 0.914      |
| SL.glm.interaction | screen_highcor_random | 0.025  | Black                            | 0.254       | 1.289      |
| SL.glm.interaction | screen_highcor_random | 0.025  | Asian                            | 0.060       | 1.061      |
| SL.glm.interaction | screen_highcor_random | 0.025  | NatAmer                          | -0.012      | 0.988      |
| SL.glm.interaction | screen_highcor_random | 0.025  | PacIsl                           | -0.085      | 0.918      |
| SL.glm.interaction | screen_highcor_random | 0.025  | Multiracial                      | -0.117      | 0.889      |
| SL.glm.interaction | screen_highcor_random | 0.025  | Other                            | -0.073      | 0.929      |
| SL.glm.interaction | screen_highcor_random | 0.025  | Notreported                      | 0.018       | 1.018      |
| SL.glm.interaction | screen_highcor_random | 0.025  | Unknown                          | -0.073      | 0.929      |
| SL.glm.interaction | screen_highcor_random | 0.025  | HighRiskInd                      | 0.880       | 2.412      |
| SL.glm.interaction | screen_highcor_random | 0.025  | Sex                              | 0.069       | 1.071      |
| SL.glm.interaction | screen_highcor_random | 0.025  | Age                              | 0.806       | 2.239      |
| SL.glm.interaction | screen_highcor_random | 0.025  | BMI                              | -0.024      | 0.976      |
| SL.glm.interaction | screen_highcor_random | 0.025  | MinorityInd:EthnicityHispanic    | NA          | NA         |
| SL.glm.interaction | screen_highcor_random | 0.025  | MinorityInd:EthnicityNotreported | -1.351      | 0.259      |
| SL.glm.interaction | screen_highcor_random | 0.025  | MinorityInd:EthnicityUnknown     | 0.106       | 1.112      |
| SL.glm.interaction | screen_highcor_random | 0.025  | MinorityInd:Black                | NA          | NA         |
| SL.glm.interaction | screen_highcor_random | 0.025  | MinorityInd:Asian                | NA          | NA         |
| SL.glm.interaction | screen_highcor_random | 0.025  | MinorityInd:NatAmer              | NA          | NA         |

Table 1.4: Predictors in learners assigned weight  $> 0.0$  by Superlearner. (continued)

| Learner            | Screen                | Weight | Predictors                             | Coefficient | Odds.Ratio |
|--------------------|-----------------------|--------|--|-------------|------------|
| SL.glm.interaction | screen_highcor_random | 0.025  | MinorityInd:PacIsl                     | NA          | NA         |
| SL.glm.interaction | screen_highcor_random | 0.025  | MinorityInd:Multiracial                | NA          | NA         |
| SL.glm.interaction | screen_highcor_random | 0.025  | MinorityInd:Other                      | NA          | NA         |
| SL.glm.interaction | screen_highcor_random | 0.025  | MinorityInd:Notreported                | 0.054       | 1.055      |
| SL.glm.interaction | screen_highcor_random | 0.025  | MinorityInd:Unknown                    | 0.045       | 1.046      |
| SL.glm.interaction | screen_highcor_random | 0.025  | MinorityInd:HighRiskInd                | 0.196       | 1.217      |
| SL.glm.interaction | screen_highcor_random | 0.025  | MinorityInd:Sex                        | 0.181       | 1.199      |
| SL.glm.interaction | screen_highcor_random | 0.025  | MinorityInd:Age                        | -0.201      | 0.818      |
| SL.glm.interaction | screen_highcor_random | 0.025  | MinorityInd:BMI                        | 0.087       | 1.091      |
| SL.glm.interaction | screen_highcor_random | 0.025  | EthnicityHispanic:EthnicityNotreported | NA          | NA         |
| SL.glm.interaction | screen_highcor_random | 0.025  | EthnicityHispanic:EthnicityUnknown     | NA          | NA         |
| SL.glm.interaction | screen_highcor_random | 0.025  | EthnicityHispanic:Black                | -0.018      | 0.982      |
| SL.glm.interaction | screen_highcor_random | 0.025  | EthnicityHispanic:Asian                | -0.096      | 0.908      |
| SL.glm.interaction | screen_highcor_random | 0.025  | EthnicityHispanic:NatAmer              | 0.028       | 1.029      |
| SL.glm.interaction | screen_highcor_random | 0.025  | EthnicityHispanic:PacIsl               | 0.279       | 1.321      |
| SL.glm.interaction | screen_highcor_random | 0.025  | EthnicityHispanic:Multiracial          | 0.049       | 1.050      |
| SL.glm.interaction | screen_highcor_random | 0.025  | EthnicityHispanic:Other                | NA          | NA         |
| SL.glm.interaction | screen_highcor_random | 0.025  | EthnicityHispanic:Notreported          | NA          | NA         |
| SL.glm.interaction | screen_highcor_random | 0.025  | EthnicityHispanic:Unknown              | NA          | NA         |
| SL.glm.interaction | screen_highcor_random | 0.025  | EthnicityHispanic:HighRiskInd          | -0.081      | 0.923      |
| SL.glm.interaction | screen_highcor_random | 0.025  | EthnicityHispanic:Sex                  | -0.073      | 0.929      |
| SL.glm.interaction | screen_highcor_random | 0.025  | EthnicityHispanic:Age                  | 0.118       | 1.125      |
| SL.glm.interaction | screen_highcor_random | 0.025  | EthnicityHispanic:BMI                  | -0.085      | 0.919      |
| SL.glm.interaction | screen_highcor_random | 0.025  | EthnicityNotreported:EthnicityUnknown  | NA          | NA         |
| SL.glm.interaction | screen_highcor_random | 0.025  | EthnicityNotreported:Black             | 0.972       | 2.643      |
| SL.glm.interaction | screen_highcor_random | 0.025  | EthnicityNotreported:Asian             | 0.643       | 1.902      |
| SL.glm.interaction | screen_highcor_random | 0.025  | EthnicityNotreported:NatAmer           | -0.011      | 0.989      |
| SL.glm.interaction | screen_highcor_random | 0.025  | EthnicityNotreported:PacIsl            | 0.369       | 1.446      |
| SL.glm.interaction | screen_highcor_random | 0.025  | EthnicityNotreported:Multiracial       | 0.046       | 1.047      |
| SL.glm.interaction | screen_highcor_random | 0.025  | EthnicityNotreported:Other             | NA          | NA         |
| SL.glm.interaction | screen_highcor_random | 0.025  | EthnicityNotreported:Notreported       | 0.000       | 1.000      |
| SL.glm.interaction | screen_highcor_random | 0.025  | EthnicityNotreported:Unknown           | 0.023       | 1.024      |
| SL.glm.interaction | screen_highcor_random | 0.025  | EthnicityNotreported:HighRiskInd       | 0.035       | 1.035      |
| SL.glm.interaction | screen_highcor_random | 0.025  | EthnicityNotreported:Sex               | -0.117      | 0.889      |
| SL.glm.interaction | screen_highcor_random | 0.025  | EthnicityNotreported:Age               | 0.011       | 1.011      |
| SL.glm.interaction | screen_highcor_random | 0.025  | EthnicityNotreported:BMI               | -0.020      | 0.981      |
| SL.glm.interaction | screen_highcor_random | 0.025  | EthnicityUnknown:Black                 | -0.059      | 0.942      |
| SL.glm.interaction | screen_highcor_random | 0.025  | EthnicityUnknown:Asian                 | -0.075      | 0.928      |
| SL.glm.interaction | screen_highcor_random | 0.025  | EthnicityUnknown:NatAmer               | -0.026      | 0.974      |
| SL.glm.interaction | screen_highcor_random | 0.025  | EthnicityUnknown:PacIsl                | -0.309      | 0.734      |
| SL.glm.interaction | screen_highcor_random | 0.025  | EthnicityUnknown:Multiracial           | -0.013      | 0.987      |
| SL.glm.interaction | screen_highcor_random | 0.025  | EthnicityUnknown:Other                 | NA          | NA         |
| SL.glm.interaction | screen_highcor_random | 0.025  | EthnicityUnknown:Notreported           | 0.008       | 1.008      |
| SL.glm.interaction | screen_highcor_random | 0.025  | EthnicityUnknown:Unknown               | 0.029       | 1.029      |
| SL.glm.interaction | screen_highcor_random | 0.025  | EthnicityUnknown:HighRiskInd           | 0.044       | 1.045      |

Table 1.4: Predictors in learners assigned weight &gt; 0.0 by Superlearner. (continued)

| Learner            | Screen                | Weight | Predictors              | Coefficient | Odds.Ratio |
|--------------------|-----------------------|--------|-------------------------|-------------|------------|
| SL.glm.interaction | screen_highcor_random | 0.025  | EthnicityUnknown:Sex    | -0.010      | 0.990      |
| SL.glm.interaction | screen_highcor_random | 0.025  | EthnicityUnknown:Age    | 0.009       | 1.009      |
| SL.glm.interaction | screen_highcor_random | 0.025  | EthnicityUnknown:BMI    | -0.106      | 0.900      |
| SL.glm.interaction | screen_highcor_random | 0.025  | Black:Asian             | NA          | NA         |
| SL.glm.interaction | screen_highcor_random | 0.025  | Black:NatAmer           | NA          | NA         |
| SL.glm.interaction | screen_highcor_random | 0.025  | Black:PacIsl            | NA          | NA         |
| SL.glm.interaction | screen_highcor_random | 0.025  | Black:Multiracial       | NA          | NA         |
| SL.glm.interaction | screen_highcor_random | 0.025  | Black:Other             | NA          | NA         |
| SL.glm.interaction | screen_highcor_random | 0.025  | Black:Notreported       | NA          | NA         |
| SL.glm.interaction | screen_highcor_random | 0.025  | Black:Unknown           | NA          | NA         |
| SL.glm.interaction | screen_highcor_random | 0.025  | Black:HighRiskInd       | -0.183      | 0.832      |
| SL.glm.interaction | screen_highcor_random | 0.025  | Black:Sex               | -0.132      | 0.876      |
| SL.glm.interaction | screen_highcor_random | 0.025  | Black:Age               | 0.181       | 1.199      |
| SL.glm.interaction | screen_highcor_random | 0.025  | Black:BMI               | -0.058      | 0.944      |
| SL.glm.interaction | screen_highcor_random | 0.025  | Asian:NatAmer           | NA          | NA         |
| SL.glm.interaction | screen_highcor_random | 0.025  | Asian:PacIsl            | NA          | NA         |
| SL.glm.interaction | screen_highcor_random | 0.025  | Asian:Multiracial       | NA          | NA         |
| SL.glm.interaction | screen_highcor_random | 0.025  | Asian:Other             | NA          | NA         |
| SL.glm.interaction | screen_highcor_random | 0.025  | Asian:Notreported       | NA          | NA         |
| SL.glm.interaction | screen_highcor_random | 0.025  | Asian:Unknown           | NA          | NA         |
| SL.glm.interaction | screen_highcor_random | 0.025  | Asian:HighRiskInd       | -0.061      | 0.941      |
| SL.glm.interaction | screen_highcor_random | 0.025  | Asian:Sex               | -0.104      | 0.901      |
| SL.glm.interaction | screen_highcor_random | 0.025  | Asian:Age               | 0.153       | 1.165      |
| SL.glm.interaction | screen_highcor_random | 0.025  | Asian:BMI               | -0.078      | 0.925      |
| SL.glm.interaction | screen_highcor_random | 0.025  | NatAmer:PacIsl          | NA          | NA         |
| SL.glm.interaction | screen_highcor_random | 0.025  | NatAmer:Multiracial     | NA          | NA         |
| SL.glm.interaction | screen_highcor_random | 0.025  | NatAmer:Other           | NA          | NA         |
| SL.glm.interaction | screen_highcor_random | 0.025  | NatAmer:Notreported     | NA          | NA         |
| SL.glm.interaction | screen_highcor_random | 0.025  | NatAmer:Unknown         | NA          | NA         |
| SL.glm.interaction | screen_highcor_random | 0.025  | NatAmer:HighRiskInd     | -0.086      | 0.918      |
| SL.glm.interaction | screen_highcor_random | 0.025  | NatAmer:Sex             | -0.097      | 0.907      |
| SL.glm.interaction | screen_highcor_random | 0.025  | NatAmer:Age             | -0.011      | 0.989      |
| SL.glm.interaction | screen_highcor_random | 0.025  | NatAmer:BMI             | -0.060      | 0.941      |
| SL.glm.interaction | screen_highcor_random | 0.025  | PacIsl:Multiracial      | NA          | NA         |
| SL.glm.interaction | screen_highcor_random | 0.025  | PacIsl:Other            | NA          | NA         |
| SL.glm.interaction | screen_highcor_random | 0.025  | PacIsl:Notreported      | NA          | NA         |
| SL.glm.interaction | screen_highcor_random | 0.025  | PacIsl:Unknown          | NA          | NA         |
| SL.glm.interaction | screen_highcor_random | 0.025  | PacIsl:HighRiskInd      | -0.052      | 0.949      |
| SL.glm.interaction | screen_highcor_random | 0.025  | PacIsl:Sex              | -0.098      | 0.907      |
| SL.glm.interaction | screen_highcor_random | 0.025  | PacIsl:Age              | 0.221       | 1.247      |
| SL.glm.interaction | screen_highcor_random | 0.025  | PacIsl:BMI              | -0.011      | 0.989      |
| SL.glm.interaction | screen_highcor_random | 0.025  | Multiracial:Other       | NA          | NA         |
| SL.glm.interaction | screen_highcor_random | 0.025  | Multiracial:Notreported | NA          | NA         |
| SL.glm.interaction | screen_highcor_random | 0.025  | Multiracial:Unknown     | NA          | NA         |
| SL.glm.interaction | screen_highcor_random | 0.025  | Multiracial:HighRiskInd | -0.053      | 0.948      |

Table 1.4: Predictors in learners assigned weight  $> 0.0$  by Superlearner. (continued)

| Learner            | Screen                | Weight | Predictors              | Coefficient | Odds.Ratio |
|--------------------|-----------------------|--------|-------------------------|-------------|------------|
| SL.glm.interaction | screen_highcor_random | 0.025  | Multiracial:Sex         | -0.051      | 0.950      |
| SL.glm.interaction | screen_highcor_random | 0.025  | Multiracial:Age         | 0.006       | 1.006      |
| SL.glm.interaction | screen_highcor_random | 0.025  | Multiracial:BMI         | -0.077      | 0.926      |
| SL.glm.interaction | screen_highcor_random | 0.025  | Other:Notreported       | NA          | NA         |
| SL.glm.interaction | screen_highcor_random | 0.025  | Other:Unknown           | NA          | NA         |
| SL.glm.interaction | screen_highcor_random | 0.025  | Other:HighRiskInd       | -0.007      | 0.993      |
| SL.glm.interaction | screen_highcor_random | 0.025  | Other:Sex               | -0.008      | 0.992      |
| SL.glm.interaction | screen_highcor_random | 0.025  | Other:Age               | 0.027       | 1.027      |
| SL.glm.interaction | screen_highcor_random | 0.025  | Other:BMI               | -0.066      | 0.936      |
| SL.glm.interaction | screen_highcor_random | 0.025  | Notreported:Unknown     | NA          | NA         |
| SL.glm.interaction | screen_highcor_random | 0.025  | Notreported:HighRiskInd | 0.021       | 1.021      |
| SL.glm.interaction | screen_highcor_random | 0.025  | Notreported:Sex         | -0.043      | 0.958      |
| SL.glm.interaction | screen_highcor_random | 0.025  | Notreported:Age         | 0.009       | 1.009      |
| SL.glm.interaction | screen_highcor_random | 0.025  | Notreported:BMI         | -0.004      | 0.996      |
| SL.glm.interaction | screen_highcor_random | 0.025  | Unknown:HighRiskInd     | 0.051       | 1.052      |
| SL.glm.interaction | screen_highcor_random | 0.025  | Unknown:Sex             | -0.058      | 0.944      |
| SL.glm.interaction | screen_highcor_random | 0.025  | Unknown:Age             | 0.027       | 1.028      |
| SL.glm.interaction | screen_highcor_random | 0.025  | Unknown:BMI             | 0.010       | 1.010      |
| SL.glm.interaction | screen_highcor_random | 0.025  | HighRiskInd:Sex         | 0.002       | 1.002      |
| SL.glm.interaction | screen_highcor_random | 0.025  | HighRiskInd:Age         | -0.045      | 0.956      |
| SL.glm.interaction | screen_highcor_random | 0.025  | HighRiskInd:BMI         | -0.017      | 0.983      |
| SL.glm.interaction | screen_highcor_random | 0.025  | Sex:Age                 | -0.026      | 0.974      |
| SL.glm.interaction | screen_highcor_random | 0.025  | Sex:BMI                 | -0.012      | 0.988      |
| SL.glm.interaction | screen_highcor_random | 0.025  | Age:BMI                 | -0.007      | 0.993      |

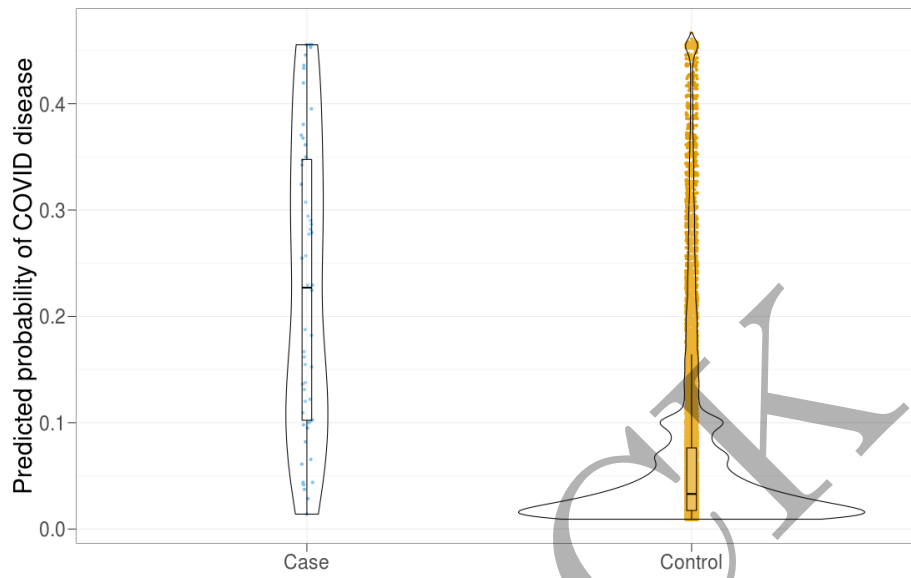


Figure 1.4: Superlearner predicted probabilities of COVID-19 disease in vaccinees 7 days after Day 57 by case/control status.

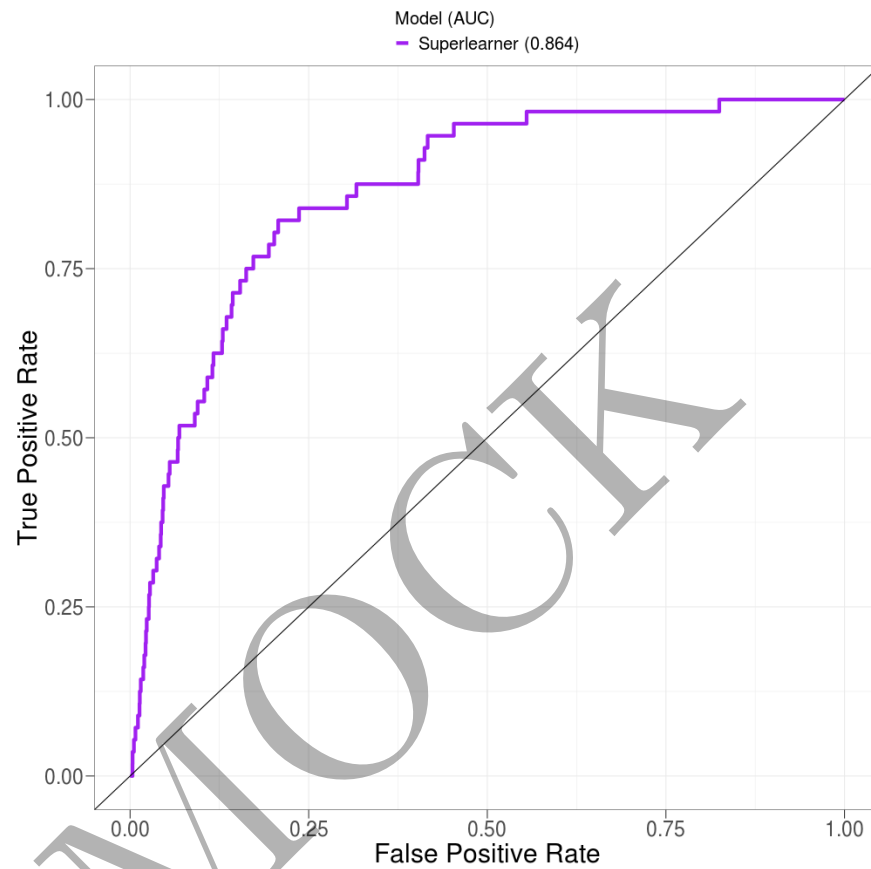


Figure 1.5: ROC curve based off Superlearner predicted probabilities in vaccinees.



## Chapter 2

# Appendix

- This report was built from the [CoVPN/correlates\\_reporting](https://github.com/CoVPN/correlates_reporting) repository with commit hash 61d21303da13f80e762b2718e0f9f8d6d254b505. A diff of the changes introduced by that commit may be viewed at [https://github.com/CoVPN/correlates\\_reporting/commit/61d21303da13f80e762b2718e0f9f8d6d254b505](https://github.com/CoVPN/correlates_reporting/commit/61d21303da13f80e762b2718e0f9f8d6d254b505)
- The sha256 hash sum of the raw input file, “COVID\_VEtrial\_practicedata\_primarystage1.csv”: 9093a3d1fd6eb4b5523bfa7df143e1bc6e1f3ee0f6b340eaf60d3859e07a1023
- The sha256 hash sum of the processed file, “practice\_data.csv”: b3eb4a4bc4134968cce332b14e8bbd891517cf559f9a3459409f644db65a1810