running-MANOVA

2022-09-15

library(tidyverse)

## ── Attaching packages ─────────────────────────────────────── tidyverse 1.3.2 ──  
## ✔ ggplot2 3.3.6 ✔ purrr 0.3.4  
## ✔ tibble 3.1.8 ✔ dplyr 1.0.9  
## ✔ tidyr 1.2.0 ✔ stringr 1.4.0  
## ✔ readr 2.1.2 ✔ forcats 0.5.1  
## ── Conflicts ────────────────────────────────────────── tidyverse\_conflicts() ──  
## ✖ dplyr::filter() masks stats::filter()  
## ✖ dplyr::lag() masks stats::lag()

library(readxl)  
library(flextable)

##   
## Attaching package: 'flextable'  
##   
## The following object is masked from 'package:purrr':  
##   
## compose

library(extrafont)

## Registering fonts with R

library(writexl)  
library(car) #Manova function

## Loading required package: carData  
##   
## Attaching package: 'car'  
##   
## The following object is masked from 'package:dplyr':  
##   
## recode  
##   
## The following object is masked from 'package:purrr':  
##   
## some

library(broom) #tidy function  
library(emmeans) #emmeans function

#times new roman tables  
my\_ft\_theme <- function(ft, ...) {  
 # Remove vertical cell padding  
 ft <- padding(ft, padding.top = 0, padding.bottom = 0, part = "all")  
   
 # Change font to TNR 11  
 ft <- font(ft, fontname = "Times New Roman", part = "all")  
 ft <- fontsize(ft, part = "all", size = 12)  
 ft  
}

chosen\_nona1 <- read\_excel("C:\\Users\\19177\\OneDrive - Colostate\\Desktop\\Dissertation\\headscan\_dissertation\\chosen\_nona1.xlsx")  
  
chosen\_nona1$gender <- as.factor(chosen\_nona1$gender)  
chosen\_nona1$race\_eth <- as.factor(chosen\_nona1$race\_eth)  
chosen\_nona1$age\_group <- as.factor(chosen\_nona1$age\_group)  
  
  
  
summary(chosen\_nona1)

## ID AA\_C BiW\_C BiW\_L   
## Length:1677 Min. :44.00 Min. :101.0 Min. : 82.0   
## Class :character 1st Qu.:56.00 1st Qu.:123.0 1st Qu.:104.0   
## Mode :character Median :60.00 Median :131.0 Median :110.0   
## Mean :60.89 Mean :132.4 Mean :110.5   
## 3rd Qu.:65.00 3rd Qu.:141.0 3rd Qu.:117.0   
## Max. :87.00 Max. :187.0 Max. :148.0   
## GoSub\_C NRB\_L ProS\_L SelP\_L   
## Min. : 49.00 Min. : 3.00 Min. :12.00 Min. :31.00   
## 1st Qu.: 88.00 1st Qu.:15.00 1st Qu.:17.00 1st Qu.:42.00   
## Median : 97.00 Median :18.00 Median :19.00 Median :44.00   
## Mean : 97.87 Mean :17.86 Mean :19.09 Mean :44.33   
## 3rd Qu.:107.00 3rd Qu.:21.00 3rd Qu.:21.00 3rd Qu.:47.00   
## Max. :152.00 Max. :34.00 Max. :27.00 Max. :58.00   
## SelM\_L SnasM\_C TrSman\_C TrTr\_C   
## Min. : 84.0 Min. : 46.00 Min. :117.0 Min. :241.0   
## 1st Qu.:110.0 1st Qu.: 68.00 1st Qu.:142.0 1st Qu.:271.0   
## Median :116.0 Median : 75.00 Median :151.0 Median :281.0   
## Mean :116.3 Mean : 74.96 Mean :152.2 Mean :281.2   
## 3rd Qu.:123.0 3rd Qu.: 82.00 3rd Qu.:161.0 3rd Qu.:291.0   
## Max. :145.0 Max. :105.00 Max. :208.0 Max. :329.0   
## TrTr\_L gender race\_eth age\_group   
## Min. :127.0 Female:994 Asian : 81 18-36:826   
## 1st Qu.:140.0 Male :681 Black : 446 37-54:777   
## Median :145.0 Other : 2 LatinX: 84 55-72: 74   
## Mean :145.7 Other : 26   
## 3rd Qu.:151.0 white :1040   
## Max. :172.0

chosen\_nona1$gender <-  
 recode\_factor(chosen\_nona1$gender, 'Female'= "Female/Other",  
 'Other' = "Female/Other")  
  
summary(chosen\_nona1$gender)

## Female/Other Male   
## 996 681

variables <- cbind(chosen\_nona1$AA\_C, chosen\_nona1$BiW\_C, chosen\_nona1$BiW\_L,   
 chosen\_nona1$GoSub\_C, chosen\_nona1$NRB\_L, chosen\_nona1$ProS\_L,  
 chosen\_nona1$SelP\_L, chosen\_nona1$SelM\_L, chosen\_nona1$SnasM\_C,  
 chosen\_nona1$TrSman\_C, chosen\_nona1$TrTr\_C, chosen\_nona1$TrTr\_L)

#<https://www.hindawi.com/journals/cmmm/2019/2173638/> Use Pillai! better for when we don’t know enough about covariance

#<https://www.sagepub.com/sites/default/files/upm-assets/9761_book_item_9761.pdf> Type III sum of squares can be used in models where there are uneven group sizes, although there needs to be at least one participant in each cell. It calculates the sum of squares after the independent variables have all been adjusted for the inclusion of all other independent variables in the model

output<-lm(variables ~ gender+race\_eth+age\_group, data=chosen\_nona1,  
 contrasts = list(gender=contr.sum, race\_eth=contr.sum, age\_group=contr.sum))  
  
manova\_out\_nona1 <- Manova(output, type="III")  
  
summary(manova\_out\_nona1)

##   
## Type III MANOVA Tests:  
##   
## Sum of squares and products for error:  
## [,1] [,2] [,3] [,4] [,5] [,6]  
## [1,] 45476.8052 -4549.501 -8216.933 12992.9366 -610.40249 9854.1458  
## [2,] -4549.5009 236078.541 166405.647 -25372.2434 21241.71247 -6612.8550  
## [3,] -8216.9325 166405.647 141224.091 6675.0563 20037.84816 -6442.1545  
## [4,] 12992.9366 -25372.243 6675.056 271970.0221 4204.68847 11900.6983  
## [5,] -610.4025 21241.712 20037.848 4204.6885 34605.00401 -839.5523  
## [6,] 9854.1458 -6612.855 -6442.155 11900.6983 -839.55227 9250.8209  
## [7,] 9379.6145 13376.504 4909.227 -7952.2293 -95.71657 1438.7326  
## [8,] -437.1848 79055.076 61340.431 13966.3125 20557.04520 1909.9715  
## [9,] -12098.0804 100105.448 82635.718 -576.3125 25325.82357 -5470.7447  
## [10,] 16252.6994 41728.245 54198.041 179407.0201 17622.08921 8489.1303  
## [11,] 24957.7665 79557.950 79631.910 90385.8571 15055.01549 5824.0423  
## [12,] 11564.6479 28575.895 33384.710 49165.3602 4750.09455 3694.8902  
## [,7] [,8] [,9] [,10] [,11] [,12]  
## [1,] 9379.61451 -437.1848 -12098.0804 16252.699 24957.766 11564.648  
## [2,] 13376.50440 79055.0764 100105.4477 41728.245 79557.950 28575.895  
## [3,] 4909.22749 61340.4314 82635.7183 54198.041 79631.910 33384.710  
## [4,] -7952.22927 13966.3125 -576.3125 179407.020 90385.857 49165.360  
## [5,] -95.71657 20557.0452 25325.8236 17622.089 15055.015 4750.095  
## [6,] 1438.73258 1909.9715 -5470.7447 8489.130 5824.042 3694.890  
## [7,] 24173.82049 22914.2309 7227.8574 1015.602 9404.851 1213.849  
## [8,] 22914.23087 114656.3144 111622.4520 42092.615 44145.478 11054.495  
## [9,] 7227.85739 111622.4520 149253.9690 32081.540 34044.899 6971.021  
## [10,] 1015.60241 42092.6147 32081.5404 202964.265 124089.726 60986.699  
## [11,] 9404.85082 44145.4780 34044.8992 124089.726 228328.261 68142.534  
## [12,] 1213.84876 11054.4955 6971.0209 60986.699 68142.534 56046.305  
##   
## ------------------------------------------  
##   
## Term: (Intercept)   
##   
## Sum of squares and products for the hypothesis:  
## [,1] [,2] [,3] [,4] [,5] [,6] [,7]  
## [1,] 1034223.5 2205716.4 1850065.5 1670079.7 299303.61 313201.66 748311.6  
## [2,] 2205716.4 4704191.3 3945685.0 3561824.4 638332.94 667973.69 1595944.5  
## [3,] 1850065.5 3945685.0 3309480.6 2987513.9 535407.79 560269.25 1338613.6  
## [4,] 1670079.7 3561824.4 2987513.9 2696870.1 483320.02 505762.80 1208385.0  
## [5,] 299303.6 638332.9 535407.8 483320.0 86618.28 90640.36 216560.9  
## [6,] 313201.7 667973.7 560269.3 505762.8 90640.36 94849.21 226616.8  
## [7,] 748311.6 1595944.5 1338613.6 1208385.0 216560.91 226616.83 541440.3  
## [8,] 1935808.9 4128552.2 3462862.2 3125973.6 560221.87 586235.56 1400653.1  
## [9,] 1241232.7 2647210.7 2220373.1 2004361.5 359211.96 375891.84 898093.0  
## [10,] 2578771.7 5499816.5 4613023.1 4164239.7 746294.90 780948.82 1865868.4  
## [11,] 4744246.0 10118182.2 8486721.1 7661080.5 1372981.78 1436735.67 3432695.7  
## [12,] 2468939.1 5265573.5 4416549.6 3986880.4 714509.42 747687.40 1786399.1  
## [,8] [,9] [,10] [,11] [,12]  
## [1,] 1935808.9 1241232.7 2578771.7 4744246 2468939.1  
## [2,] 4128552.2 2647210.7 5499816.5 10118182 5265573.5  
## [3,] 3462862.2 2220373.1 4613023.1 8486721 4416549.6  
## [4,] 3125973.6 2004361.5 4164239.7 7661080 3986880.4  
## [5,] 560221.9 359212.0 746294.9 1372982 714509.4  
## [6,] 586235.6 375891.8 780948.8 1436736 747687.4  
## [7,] 1400653.1 898093.0 1865868.4 3432696 1786399.1  
## [8,] 3623352.5 2323278.8 4826818.9 8880048 4621239.6  
## [9,] 2323278.8 1489676.8 3094936.4 5693850 2963119.9  
## [10,] 4826818.9 3094936.4 6430006.6 11829482 6156145.9  
## [11,] 8880047.8 5693850.2 11829481.7 21763063 11325651.7  
## [12,] 4621239.6 2963119.9 6156145.9 11325652 5893949.2  
##   
## Multivariate Tests: (Intercept)  
## Df test stat approx F num Df den Df Pr(>F)   
## Pillai 1 0.99355 21284.04 12 1658 < 2.22e-16 \*\*\*  
## Wilks 1 0.00645 21284.04 12 1658 < 2.22e-16 \*\*\*  
## Hotelling-Lawley 1 154.04610 21284.04 12 1658 < 2.22e-16 \*\*\*  
## Roy 1 154.04610 21284.04 12 1658 < 2.22e-16 \*\*\*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## ------------------------------------------  
##   
## Term: gender   
##   
## Sum of squares and products for the hypothesis:  
## [,1] [,2] [,3] [,4] [,5] [,6] [,7]  
## [1,] 16530.560 22498.497 9293.382 29112.933 -1837.8126 2992.5581 9451.536  
## [2,] 22498.497 30621.004 12648.519 39623.414 -2501.3080 4072.9448 12863.772  
## [3,] 9293.382 12648.519 5224.683 16367.116 -1033.2072 1682.3982 5313.597  
## [4,] 29112.933 39623.414 16367.116 51272.484 -3236.6790 5270.3686 16645.652  
## [5,] -1837.813 -2501.308 -1033.207 -3236.679 204.3219 -332.7026 -1050.790  
## [6,] 2992.558 4072.945 1682.398 5270.369 -332.7026 541.7484 1711.029  
## [7,] 9451.536 12863.772 5313.597 16645.652 -1050.7903 1711.0292 5404.024  
## [8,] 20248.900 27559.249 11383.810 35661.519 -2251.2053 3665.6962 11577.540  
## [9,] 13152.085 17900.309 7394.023 23162.904 -1462.2050 2380.9464 7519.855  
## [10,] 35822.660 48755.516 20139.284 63089.375 -3982.6440 6485.0429 20482.014  
## [11,] 35279.297 48015.986 19833.808 62132.426 -3922.2347 6386.6768 20171.340  
## [12,] 24683.507 33594.857 13876.919 43471.564 -2744.2302 4468.5014 14113.077  
## [,8] [,9] [,10] [,11] [,12]  
## [1,] 20248.900 13152.085 35822.660 35279.297 24683.507  
## [2,] 27559.249 17900.309 48755.516 48015.986 33594.857  
## [3,] 11383.810 7394.023 20139.284 19833.808 13876.919  
## [4,] 35661.519 23162.904 63089.375 62132.426 43471.564  
## [5,] -2251.205 -1462.205 -3982.644 -3922.235 -2744.230  
## [6,] 3665.696 2380.946 6485.043 6386.677 4468.501  
## [7,] 11577.540 7519.855 20482.014 20171.340 14113.077  
## [8,] 24803.634 16110.480 43880.513 43214.928 30235.750  
## [9,] 16110.480 10464.094 28501.313 28069.001 19638.753  
## [10,] 43880.513 28501.313 77629.731 76452.233 53490.558  
## [11,] 43214.928 28069.001 76452.233 75292.595 52679.206  
## [12,] 30235.750 19638.753 53490.558 52679.206 36857.525  
##   
## Multivariate Tests: gender  
## Df test stat approx F num Df den Df Pr(>F)   
## Pillai 1 0.6019071 208.9048 12 1658 < 2.22e-16 \*\*\*  
## Wilks 1 0.3980929 208.9048 12 1658 < 2.22e-16 \*\*\*  
## Hotelling-Lawley 1 1.5119765 208.9048 12 1658 < 2.22e-16 \*\*\*  
## Roy 1 1.5119765 208.9048 12 1658 < 2.22e-16 \*\*\*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## ------------------------------------------  
##   
## Term: race\_eth   
##   
## Sum of squares and products for the hypothesis:  
## [,1] [,2] [,3] [,4] [,5] [,6]  
## [1,] 682.42775 1447.8169 1062.947 1612.239 663.3556 -70.33084  
## [2,] 1447.81693 3095.3219 2319.907 3462.389 1411.6596 -173.81997  
## [3,] 1062.94674 2319.9072 7144.346 6753.638 3636.9194 -2407.25302  
## [4,] 1612.23911 3462.3893 6753.638 7591.428 3458.0048 -1741.73026  
## [5,] 663.35559 1411.6596 3636.919 3458.005 1944.7398 -1213.95362  
## [6,] -70.33084 -173.8200 -2407.253 -1741.730 -1213.9536 1050.37152  
## [7,] -134.39488 -296.4540 -2823.725 -2441.487 -1368.1531 1071.72697  
## [8,] 1684.32274 3546.5386 4257.139 5429.421 2420.6373 -793.73621  
## [9,] 2477.28162 5270.1837 12157.548 12507.413 6386.0073 -3653.94663  
## [10,] 1674.02433 3565.6667 7051.705 7848.802 3663.1212 -1858.16856  
## [11,] 2032.17456 4329.2654 10766.196 11186.197 5536.9934 -3204.33935  
## [12,] 440.32793 957.8871 3927.234 3582.034 1974.2667 -1391.35692  
## [,7] [,8] [,9] [,10] [,11] [,12]  
## [1,] -134.3949 1684.3227 2477.282 1674.024 2032.175 440.3279  
## [2,] -296.4540 3546.5386 5270.184 3565.667 4329.265 957.8871  
## [3,] -2823.7250 4257.1394 12157.548 7051.705 10766.196 3927.2335  
## [4,] -2441.4873 5429.4211 12507.413 7848.802 11186.197 3582.0337  
## [5,] -1368.1531 2420.6373 6386.007 3663.121 5536.993 1974.2667  
## [6,] 1071.7270 -793.7362 -3653.947 -1858.169 -3204.339 -1391.3569  
## [7,] 1306.9295 -1182.0910 -4552.519 -2564.881 -4175.142 -1649.0717  
## [8,] -1182.0910 4794.7784 8824.468 5683.866 7588.324 2091.5328  
## [9,] -4552.5188 8824.4680 21933.667 13123.591 19335.249 6565.6009  
## [10,] -2564.8809 5683.8663 13123.591 8165.080 11690.752 3756.8265  
## [11,] -4175.1416 7588.3238 19335.249 11690.752 17271.917 5875.8364  
## [12,] -1649.0717 2091.5328 6565.601 3756.826 5875.836 2209.5267  
##   
## Multivariate Tests: race\_eth  
## Df test stat approx F num Df den Df Pr(>F)   
## Pillai 4 0.4554384 17.78507 48 6644.000 < 2.22e-16 \*\*\*  
## Wilks 4 0.5814984 20.11494 48 6388.828 < 2.22e-16 \*\*\*  
## Hotelling-Lawley 4 0.6571579 22.67879 48 6626.000 < 2.22e-16 \*\*\*  
## Roy 4 0.5480977 75.86585 12 1661.000 < 2.22e-16 \*\*\*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## ------------------------------------------  
##   
## Term: age\_group   
##   
## Sum of squares and products for the hypothesis:  
## [,1] [,2] [,3] [,4] [,5] [,6]  
## [1,] 2245.0109 -414.67807 -936.63591 7685.737 -441.59414 905.6596  
## [2,] -414.6781 465.66187 447.36678 -1251.706 101.27287 -110.2665  
## [3,] -936.6359 447.36678 584.24351 -3088.127 198.13239 -337.6400  
## [4,] 7685.7373 -1251.70647 -3088.12664 26384.410 -1503.28064 3125.1136  
## [5,] -441.5941 101.27287 198.13239 -1503.281 87.85972 -175.2555  
## [6,] 905.6596 -110.26652 -337.64002 3125.114 -175.25554 373.7083  
## [7,] 579.0307 -85.95327 -226.76737 1991.361 -112.83184 236.6643  
## [8,] 882.6325 229.60464 -91.36359 3191.144 -153.72758 413.6046  
## [9,] -518.9018 466.48429 477.85417 -1616.468 120.84031 -155.0122  
## [10,] 6371.4920 -943.57468 -2493.71159 21913.343 -1241.45710 2604.5151  
## [11,] 2102.1668 -899.30115 -1237.39034 6976.147 -439.37842 773.1453  
## [12,] 958.4039 -302.33841 -488.21953 3226.983 -194.86506 368.2650  
## [,7] [,8] [,9] [,10] [,11] [,12]  
## [1,] 579.03065 882.63252 -518.9018 6371.4920 2102.1668 958.4039  
## [2,] -85.95327 229.60464 466.4843 -943.5747 -899.3011 -302.3384  
## [3,] -226.76737 -91.36359 477.8542 -2493.7116 -1237.3903 -488.2195  
## [4,] 1991.36087 3191.14409 -1616.4683 21913.3432 6976.1468 3226.9832  
## [5,] -112.83184 -153.72758 120.8403 -1241.4571 -439.3784 -194.8651  
## [6,] 236.66431 413.60465 -155.0122 2604.5151 773.1453 368.2650  
## [7,] 150.47641 248.84031 -113.8292 1655.9209 514.6066 240.4267  
## [8,] 248.84031 743.24903 170.0308 2740.4210 310.7758 250.3387  
## [9,] -113.82924 170.03082 473.0182 -1250.4198 -972.6886 -340.8964  
## [10,] 1655.92094 2740.42099 -1250.4198 18222.6305 5659.6569 2644.8703  
## [11,] 514.60656 310.77576 -972.6886 5659.6569 2639.5801 1062.0090  
## [12,] 240.42675 250.33865 -340.8964 2644.8703 1062.0090 449.5065  
##   
## Multivariate Tests: age\_group  
## Df test stat approx F num Df den Df Pr(>F)   
## Pillai 2 0.1722783 13.03123 24 3318 < 2.22e-16 \*\*\*  
## Wilks 2 0.8300655 13.48497 24 3316 < 2.22e-16 \*\*\*  
## Hotelling-Lawley 2 0.2019006 13.93956 24 3314 < 2.22e-16 \*\*\*  
## Roy 2 0.1867838 25.82286 12 1659 < 2.22e-16 \*\*\*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

#<https://www.sagepub.com/sites/default/files/upm-assets/9761_book_item_9761.pdf> Type I, hierarchical or sequential sums of squares, is appropriate when the groups in the MANOVA are of equal sizes. Type I sum of squares provides a breakdown of the sums of squares for the whole model used in the MANOVA but it is particularly sensitive to the order in which the independent variables are placed in the model. If a variable is entered first, it is not adjusted for any of the other variables; if it is entered second, it is adjusted for one other variable (the first one entered); if it is placed third, it will be adjusted for the two other variables already entered.

output1<-manova(variables ~ gender+race\_eth+age\_group, data=chosen\_nona1)  
  
#type 3 and type 1 give same Pillai values  
  
summary(output1)

## Df Pillai approx F num Df den Df Pr(>F)   
## gender 1 0.59658 204.318 12 1658 < 2.2e-16 \*\*\*  
## race\_eth 4 0.46339 18.136 48 6644 < 2.2e-16 \*\*\*  
## age\_group 2 0.17228 13.031 24 3318 < 2.2e-16 \*\*\*  
## Residuals 1669   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

output2<-as.data.frame(tidy(output1))  
output2$signif <- with(output2, ifelse(p.value < 0.05, 'TRUE', 'FALSE'))  
output2$p.value <- formatC(output2$p.value, format = "e")  
  
output2 <- rename(output2, f.statistic = statistic)  
  
#Autofit Width Table TNR  
flextable(output2) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("Additive MANOVA Model Findings") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

**Table** **1**: Additive MANOVA Model Findings

| **term** | **df** | **pillai** | **f.statistic** | **num.df** | **den.df** | **p.value** | **signif** |
| --- | --- | --- | --- | --- | --- | --- | --- |
| gender | 1 | 0.5965760 | 204.31834 | 12 | 1,658 | 3.7844e-316 | TRUE |
| race\_eth | 4 | 0.4633947 | 18.13647 | 48 | 6,644 | 2.9518e-141 | TRUE |
| age\_group | 2 | 0.1722783 | 13.03123 | 24 | 3,318 | 1.7910e-49 | TRUE |
| Residuals | 1,669 |  |  |  |  | NA |  |

From 511 notes:

The experimentwise error rate (EER) is the probability of having at least one false rejection in the group of tests from a single experiment or study. The “experiment” is the ANOVA analysis.

John Tukey proposed a method that can be used to run all pairwise comparisons while controlling EER.

Tukey ME > Unadj ME, hence we will find evidence of fewer differences (or weaker evidence of differences) using Tukey’s method.

AA\_Cout <- aov(AA\_C ~ gender+race\_eth+age\_group, data=chosen\_nona1)  
summary(AA\_Cout)

## Df Sum Sq Mean Sq F value Pr(>F)   
## gender 1 15854 15854 581.858 < 2e-16 \*\*\*  
## race\_eth 4 923 231 8.467 9.22e-07 \*\*\*  
## age\_group 2 2245 1123 41.196 < 2e-16 \*\*\*  
## Residuals 1669 45477 27   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

AA\_Cout\_data <- as.data.frame(tidy(AA\_Cout))

AA\_Cout\_data <- rename(AA\_Cout\_data, f.statistic = statistic)  
AA\_Cout\_data$signif <- with(AA\_Cout\_data, ifelse(p.value < 0.05, 'TRUE', 'FALSE'))  
AA\_Cout\_data$p.value <- formatC(AA\_Cout\_data$p.value, format = "e")  
  
  
  
AA\_Cout\_data <- AA\_Cout\_data %>%   
 mutate(across(where(is.numeric), round, digits=3))  
  
#Autofit Width Table TNR  
flextable(AA\_Cout\_data) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("AA\_C Additive Anova Model Findings") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

**Table** **2**: AA\_C Additive Anova Model Findings

| **term** | **df** | **sumsq** | **meansq** | **f.statistic** | **p.value** | **signif** |
| --- | --- | --- | --- | --- | --- | --- |
| gender | 1 | 15,854.442 | 15,854.442 | 581.858 | 1.5450e-110 | TRUE |
| race\_eth | 4 | 922.848 | 230.712 | 8.467 | 9.2175e-07 | TRUE |
| age\_group | 2 | 2,245.011 | 1,122.505 | 41.196 | 3.4388e-18 | TRUE |
| Residuals | 1,669 | 45,476.805 | 27.248 |  | NA |  |

AA\_Cg\_em <- emmeans(AA\_Cout, ~ gender)  
AA\_Cg\_em1 <- as.data.frame(AA\_Cg\_em)  
  
AA\_Cg\_em

## gender emmean SE df lower.CL upper.CL  
## Female/Other 58.5 0.341 1669 57.8 59.1  
## Male 64.9 0.344 1669 64.2 65.6  
##   
## Results are averaged over the levels of: race\_eth, age\_group   
## Confidence level used: 0.95

AA\_Cg\_em1<- AA\_Cg\_em1 %>%   
 mutate(across(where(is.numeric), round, digits=3))  
  
flextable(AA\_Cg\_em1) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("Estimated Marginal Means: AA\_C and Gender") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

**Table 3**: Estimated Marginal Means: AA\_C and Gender

| **gender** | **emmean** | **SE** | **df** | **lower.CL** | **upper.CL** |
| --- | --- | --- | --- | --- | --- |
| Female/Other | 58.462 | 0.341 | 1,669 | 57.792 | 59.131 |
| Male | 64.902 | 0.344 | 1,669 | 64.228 | 65.576 |

AA\_Cg\_em2 <- pairs(AA\_Cg\_em, adjust="Tukey")  
AA\_Cg\_em3 <- as.data.frame(AA\_Cg\_em2)  
  
AA\_Cg\_em3$signif <- with(AA\_Cg\_em3, ifelse(p.value < 0.05, 'TRUE', 'FALSE'))  
AA\_Cg\_em3$p.value <- formatC(AA\_Cg\_em3$p.value, format = "e")  
  
AA\_Cg\_em2

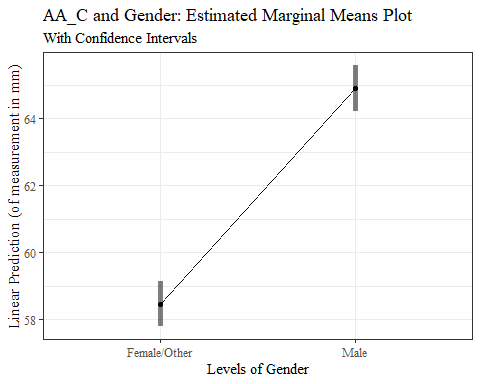
## contrast estimate SE df t.ratio p.value  
## (Female/Other) - Male -6.44 0.261 1669 -24.631 <.0001  
##   
## Results are averaged over the levels of: race\_eth, age\_group

AA\_Cg\_em3<- AA\_Cg\_em3 %>%   
 mutate(across(where(is.numeric), round, digits=3))  
  
flextable(AA\_Cg\_em3) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("Tukey Pairwise Comparisons: AA\_C and Gender") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

**Table** **4**: Tukey Pairwise Comparisons: AA\_C and Gender

| **contrast** | **estimate** | **SE** | **df** | **t.ratio** | **p.value** | **signif** |
| --- | --- | --- | --- | --- | --- | --- |
| (Female/Other) - Male | -6.44 | 0.261 | 1,669 | -24.631 | 1.6174e-114 | TRUE |

emmip\_AA\_Cg <- emmip(AA\_Cout, ~ gender, CIs = TRUE)  
  
emmip\_AA\_Cg +   
 theme\_bw()+theme(text=element\_text(family= "Times New Roman"))+  
 labs(title="AA\_C and Gender: Estimated Marginal Means Plot",  
 subtitle="With Confidence Intervals",  
 y="Linear Prediction (of measurement in mm)",  
 x="Levels of Gender")



AA\_Cr\_em <- emmeans(AA\_Cout, ~ race\_eth)  
AA\_Cr\_em1 <- as.data.frame(AA\_Cr\_em)  
  
AA\_Cr\_em

## race\_eth emmean SE df lower.CL upper.CL  
## Asian 59.6 0.612 1669 58.4 60.8  
## Black 62.7 0.304 1669 62.1 63.3  
## LatinX 62.0 0.597 1669 60.8 63.2  
## Other 62.0 1.030 1669 60.0 64.0  
## white 62.1 0.245 1669 61.6 62.6  
##   
## Results are averaged over the levels of: gender, age\_group   
## Confidence level used: 0.95

AA\_Cr\_em1<- AA\_Cr\_em1 %>%   
 mutate(across(where(is.numeric), round, digits=3))  
  
flextable(AA\_Cr\_em1) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("Estimated Marginal Means: AA\_C and Race/Ethnicity") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

**Table 5**: Estimated Marginal Means: AA\_C and Race/Ethnicity

| **race\_eth** | **emmean** | **SE** | **df** | **lower.CL** | **upper.CL** |
| --- | --- | --- | --- | --- | --- |
| Asian | 59.580 | 0.612 | 1,669 | 58.379 | 60.781 |
| Black | 62.730 | 0.304 | 1,669 | 62.133 | 63.327 |
| LatinX | 62.014 | 0.597 | 1,669 | 60.843 | 63.186 |
| Other | 61.975 | 1.030 | 1,669 | 59.956 | 63.995 |
| white | 62.110 | 0.245 | 1,669 | 61.630 | 62.590 |

AA\_Cr\_em2 <- pairs(AA\_Cr\_em, adjust="Tukey")  
AA\_Cr\_em3 <- as.data.frame(AA\_Cr\_em2)  
  
AA\_Cr\_em3$signif <- with(AA\_Cr\_em3, ifelse(p.value < 0.05, 'TRUE', 'FALSE'))  
AA\_Cr\_em3$p.value <- formatC(AA\_Cr\_em3$p.value, format = "e")  
  
  
  
AA\_Cr\_em2

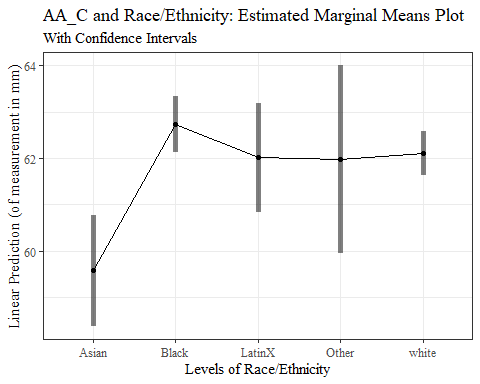
## contrast estimate SE df t.ratio p.value  
## Asian - Black -3.1502 0.633 1669 -4.974 <.0001  
## Asian - LatinX -2.4344 0.813 1669 -2.993 0.0234  
## Asian - Other -2.3958 1.180 1669 -2.030 0.2520  
## Asian - white -2.5303 0.604 1669 -4.187 0.0003  
## Black - LatinX 0.7159 0.622 1669 1.150 0.7795  
## Black - Other 0.7545 1.055 1669 0.715 0.9531  
## Black - white 0.6199 0.296 1669 2.092 0.2238  
## LatinX - Other 0.0386 1.174 1669 0.033 1.0000  
## LatinX - white -0.0960 0.593 1669 -0.162 0.9998  
## Other - white -0.1346 1.039 1669 -0.130 0.9999  
##   
## Results are averaged over the levels of: gender, age\_group   
## P value adjustment: tukey method for comparing a family of 5 estimates

AA\_Cr\_em3<- AA\_Cr\_em3 %>%   
 mutate(across(where(is.numeric), round, digits=3))  
  
flextable(AA\_Cr\_em3) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("Tukey Pairwise Comparisons: AA\_C and Race/Ethnicity") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

**Table** **6**: Tukey Pairwise Comparisons: AA\_C and Race/Ethnicity

| **contrast** | **estimate** | **SE** | **df** | **t.ratio** | **p.value** | **signif** |
| --- | --- | --- | --- | --- | --- | --- |
| Asian - Black | -3.150 | 0.633 | 1,669 | -4.974 | 7.1779e-06 | TRUE |
| Asian - LatinX | -2.434 | 0.813 | 1,669 | -2.993 | 2.3429e-02 | TRUE |
| Asian - Other | -2.396 | 1.180 | 1,669 | -2.030 | 2.5198e-01 | FALSE |
| Asian - white | -2.530 | 0.604 | 1,669 | -4.187 | 2.8701e-04 | TRUE |
| Black - LatinX | 0.716 | 0.622 | 1,669 | 1.150 | 7.7952e-01 | FALSE |
| Black - Other | 0.754 | 1.055 | 1,669 | 0.715 | 9.5312e-01 | FALSE |
| Black - white | 0.620 | 0.296 | 1,669 | 2.092 | 2.2380e-01 | FALSE |
| LatinX - Other | 0.039 | 1.174 | 1,669 | 0.033 | 1.0000e+00 | FALSE |
| LatinX - white | -0.096 | 0.593 | 1,669 | -0.162 | 9.9985e-01 | FALSE |
| Other - white | -0.135 | 1.039 | 1,669 | -0.130 | 9.9994e-01 | FALSE |

emmip\_AA\_Cr <- emmip(AA\_Cout, ~ race\_eth, CIs = TRUE)  
  
emmip\_AA\_Cr +   
 theme\_bw()+theme(text=element\_text(family= "Times New Roman"))+  
 labs(title="AA\_C and Race/Ethnicity: Estimated Marginal Means Plot",  
 subtitle="With Confidence Intervals",  
 y="Linear Prediction (of measurement in mm)",  
 x="Levels of Race/Ethnicity")



AA\_Ca\_em <- emmeans(AA\_Cout, ~ age\_group)  
AA\_Ca\_em1 <- as.data.frame(AA\_Ca\_em)  
  
AA\_Ca\_em

## age\_group emmean SE df lower.CL upper.CL  
## 18-36 59.9 0.296 1669 59.3 60.5  
## 37-54 62.1 0.307 1669 61.5 62.7  
## 55-72 63.1 0.642 1669 61.8 64.4  
##   
## Results are averaged over the levels of: gender, race\_eth   
## Confidence level used: 0.95

AA\_Ca\_em1<- AA\_Ca\_em1 %>%   
 mutate(across(where(is.numeric), round, digits=3))  
  
flextable(AA\_Ca\_em1) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("Estimated Marginal Means: AA\_C and Age Group") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

**Table 7**: Estimated Marginal Means: AA\_C and Age Group

| **age\_group** | **emmean** | **SE** | **df** | **lower.CL** | **upper.CL** |
| --- | --- | --- | --- | --- | --- |
| 18-36 | 59.871 | 0.296 | 1,669 | 59.291 | 60.452 |
| 37-54 | 62.075 | 0.307 | 1,669 | 61.472 | 62.678 |
| 55-72 | 63.099 | 0.642 | 1,669 | 61.840 | 64.359 |

AA\_Ca\_em2 <- pairs(AA\_Ca\_em, adjust="Tukey")  
AA\_Ca\_em3 <- as.data.frame(AA\_Ca\_em2)  
  
AA\_Ca\_em3$signif <- with(AA\_Ca\_em3, ifelse(p.value < 0.05, 'TRUE', 'FALSE'))  
AA\_Ca\_em3$p.value <- formatC(AA\_Ca\_em3$p.value, format = "e")  
  
AA\_Ca\_em2

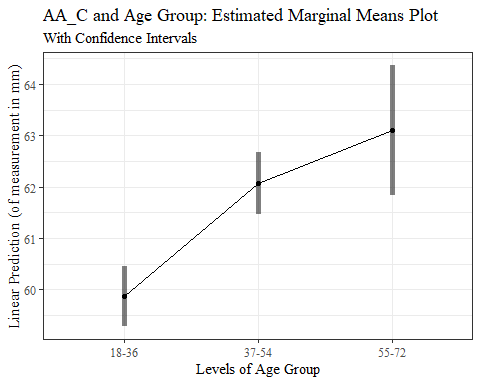
## contrast estimate SE df t.ratio p.value  
## (18-36) - (37-54) -2.20 0.263 1669 -8.383 <.0001  
## (18-36) - (55-72) -3.23 0.636 1669 -5.075 <.0001  
## (37-54) - (55-72) -1.02 0.638 1669 -1.605 0.2439  
##   
## Results are averaged over the levels of: gender, race\_eth   
## P value adjustment: tukey method for comparing a family of 3 estimates

AA\_Ca\_em3<- AA\_Ca\_em3 %>%   
 mutate(across(where(is.numeric), round, digits=3))  
  
flextable(AA\_Ca\_em3) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("Tukey Pairwise Comparisons: AA\_C and Age Group") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

**Table** **8**: Tukey Pairwise Comparisons: AA\_C and Age Group

| **contrast** | **estimate** | **SE** | **df** | **t.ratio** | **p.value** | **signif** |
| --- | --- | --- | --- | --- | --- | --- |
| (18-36) - (37-54) | -2.204 | 0.263 | 1,669 | -8.383 | 1.6358e-12 | TRUE |
| (18-36) - (55-72) | -3.228 | 0.636 | 1,669 | -5.075 | 1.2876e-06 | TRUE |
| (37-54) - (55-72) | -1.024 | 0.638 | 1,669 | -1.605 | 2.4387e-01 | FALSE |

emmip\_AA\_Ca <- emmip(AA\_Cout, ~ age\_group, CIs = TRUE)  
  
emmip\_AA\_Ca +   
 theme\_bw()+theme(text=element\_text(family= "Times New Roman"))+  
 labs(title="AA\_C and Age Group: Estimated Marginal Means Plot",  
 subtitle="With Confidence Intervals",  
 y="Linear Prediction (of measurement in mm)",  
 x="Levels of Age Group")



BiW\_Lout <- aov(BiW\_L ~ gender+race\_eth+age\_group, data=chosen\_nona1)  
summary(BiW\_Lout)

## Df Sum Sq Mean Sq F value Pr(>F)   
## gender 1 5531 5531 65.368 1.18e-15 \*\*\*  
## race\_eth 4 6973 1743 20.602 < 2e-16 \*\*\*  
## age\_group 2 584 292 3.452 0.0319 \*   
## Residuals 1669 141224 85   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

BiW\_Lout\_data <- as.data.frame(tidy(BiW\_Lout))

BiW\_Lout\_data <- rename(BiW\_Lout\_data, f.statistic = statistic)  
BiW\_Lout\_data$signif <- with(BiW\_Lout\_data, ifelse(p.value < 0.05, 'TRUE', 'FALSE'))  
BiW\_Lout\_data$p.value <- formatC(BiW\_Lout\_data$p.value, format = "e")  
  
BiW\_Lout\_data <- BiW\_Lout\_data %>%   
 mutate(across(where(is.numeric), round, digits=3))  
  
#Autofit Width Table TNR  
flextable(BiW\_Lout\_data) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("BiW\_L Additive Anova Model Findings") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

**Table** **9**: BiW\_L Additive Anova Model Findings

| **term** | **df** | **sumsq** | **meansq** | **f.statistic** | **p.value** | **signif** |
| --- | --- | --- | --- | --- | --- | --- |
| gender | 1 | 5,531.214 | 5,531.214 | 65.368 | 1.1816e-15 | TRUE |
| race\_eth | 4 | 6,973.109 | 1,743.277 | 20.602 | 1.3735e-16 | TRUE |
| age\_group | 2 | 584.244 | 292.122 | 3.452 | 3.1898e-02 | TRUE |
| Residuals | 1,669 | 141,224.091 | 84.616 |  | NA |  |

BiW\_Lg\_em <- emmeans(BiW\_Lout, ~ gender)  
BiW\_Lg\_em1 <- as.data.frame(BiW\_Lg\_em)  
  
BiW\_Lg\_em

## gender emmean SE df lower.CL upper.CL  
## Female/Other 109 0.602 1669 107 110  
## Male 112 0.606 1669 111 113  
##   
## Results are averaged over the levels of: race\_eth, age\_group   
## Confidence level used: 0.95

BiW\_Lg\_em1 <- BiW\_Lg\_em1 %>%   
 mutate(across(where(is.numeric), round, digits=3))  
  
flextable(BiW\_Lg\_em1) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("Estimated Marginal Means: BiW\_L and Gender") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

**Table 10**: Estimated Marginal Means: BiW\_L and Gender

| **gender** | **emmean** | **SE** | **df** | **lower.CL** | **upper.CL** |
| --- | --- | --- | --- | --- | --- |
| Female/Other | 108.529 | 0.602 | 1,669 | 107.349 | 109.709 |
| Male | 112.150 | 0.606 | 1,669 | 110.962 | 113.337 |

BiW\_Lg\_em2 <- pairs(BiW\_Lg\_em, adjust="Tukey")  
BiW\_Lg\_em3 <- as.data.frame(BiW\_Lg\_em2)  
  
BiW\_Lg\_em3$signif <- with(BiW\_Lg\_em3, ifelse(p.value < 0.05, 'TRUE', 'FALSE'))  
BiW\_Lg\_em3$p.value <- formatC(BiW\_Lg\_em3$p.value, format = "e")  
  
BiW\_Lg\_em2

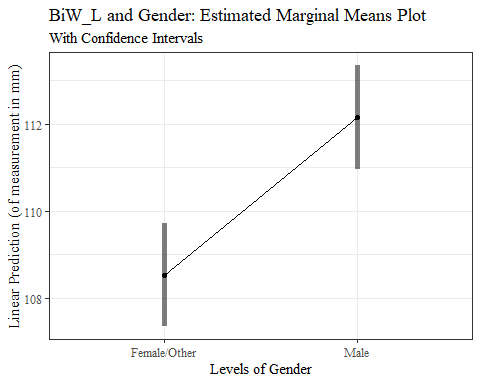
## contrast estimate SE df t.ratio p.value  
## (Female/Other) - Male -3.62 0.461 1669 -7.858 <.0001  
##   
## Results are averaged over the levels of: race\_eth, age\_group

BiW\_Lg\_em3 <- BiW\_Lg\_em3 %>%   
 mutate(across(where(is.numeric), round, digits=3))  
  
  
flextable(BiW\_Lg\_em3) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("Tukey Pairwise Comparisons: BiW\_L and Gender") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

**Table** **11**: Tukey Pairwise Comparisons: BiW\_L and Gender

| **contrast** | **estimate** | **SE** | **df** | **t.ratio** | **p.value** | **signif** |
| --- | --- | --- | --- | --- | --- | --- |
| (Female/Other) - Male | -3.621 | 0.461 | 1,669 | -7.858 | 6.9475e-15 | TRUE |

emmip\_BiW\_Lg <- emmip(BiW\_Lout, ~ gender, CIs = TRUE)  
  
emmip\_BiW\_Lg +   
 theme\_bw()+theme(text=element\_text(family= "Times New Roman"))+  
 labs(title="BiW\_L and Gender: Estimated Marginal Means Plot",  
 subtitle="With Confidence Intervals",  
 y="Linear Prediction (of measurement in mm)",  
 x="Levels of Gender")



BiW\_Lr\_em <- emmeans(BiW\_Lout, ~ race\_eth)  
BiW\_Lr\_em1 <- as.data.frame(BiW\_Lr\_em)  
  
BiW\_Lr\_em

## race\_eth emmean SE df lower.CL upper.CL  
## Asian 109 1.079 1669 107 112  
## Black 114 0.536 1669 112 115  
## LatinX 110 1.053 1669 108 112  
## Other 110 1.815 1669 106 113  
## white 109 0.431 1669 108 110  
##   
## Results are averaged over the levels of: gender, age\_group   
## Confidence level used: 0.95

BiW\_Lr\_em1 <- BiW\_Lr\_em1 %>%   
 mutate(across(where(is.numeric), round, digits=3))  
  
flextable(BiW\_Lr\_em1) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("Estimated Marginal Means: BiW\_L and Race/Ethnicity") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

**Table 12**: Estimated Marginal Means: BiW\_L and Race/Ethnicity

| **race\_eth** | **emmean** | **SE** | **df** | **lower.CL** | **upper.CL** |
| --- | --- | --- | --- | --- | --- |
| Asian | 109.471 | 1.079 | 1,669 | 107.355 | 111.588 |
| Black | 113.530 | 0.536 | 1,669 | 112.478 | 114.582 |
| LatinX | 110.319 | 1.053 | 1,669 | 108.254 | 112.383 |
| Other | 109.627 | 1.815 | 1,669 | 106.067 | 113.186 |
| white | 108.749 | 0.431 | 1,669 | 107.903 | 109.594 |

BiW\_Lr\_em2 <- pairs(BiW\_Lr\_em, adjust="Tukey")  
BiW\_Lr\_em3 <- as.data.frame(BiW\_Lr\_em2)  
  
BiW\_Lr\_em3$signif <- with(BiW\_Lr\_em3, ifelse(p.value < 0.05, 'TRUE', 'FALSE'))  
BiW\_Lr\_em3$p.value <- formatC(BiW\_Lr\_em3$p.value, format = "e")  
  
BiW\_Lr\_em2

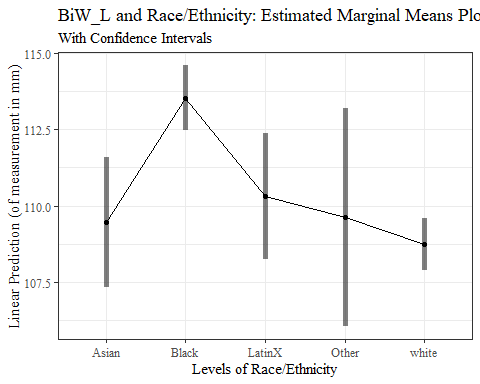
## contrast estimate SE df t.ratio p.value  
## Asian - Black -4.059 1.116 1669 -3.637 0.0026  
## Asian - LatinX -0.847 1.433 1669 -0.591 0.9764  
## Asian - Other -0.155 2.080 1669 -0.075 1.0000  
## Asian - white 0.723 1.065 1669 0.679 0.9611  
## Black - LatinX 3.212 1.097 1669 2.929 0.0284  
## Black - Other 3.904 1.860 1669 2.099 0.2208  
## Black - white 4.782 0.522 1669 9.158 <.0001  
## LatinX - Other 0.692 2.068 1669 0.335 0.9973  
## LatinX - white 1.570 1.045 1669 1.503 0.5607  
## Other - white 0.878 1.831 1669 0.480 0.9892  
##   
## Results are averaged over the levels of: gender, age\_group   
## P value adjustment: tukey method for comparing a family of 5 estimates

BiW\_Lr\_em3 <- BiW\_Lr\_em3 %>%   
 mutate(across(where(is.numeric), round, digits=3))  
  
flextable(BiW\_Lr\_em3) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("Tukey Pairwise Comparisons: BiW\_L and Race/Ethnicity") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

**Table** **13**: Tukey Pairwise Comparisons: BiW\_L and Race/Ethnicity

| **contrast** | **estimate** | **SE** | **df** | **t.ratio** | **p.value** | **signif** |
| --- | --- | --- | --- | --- | --- | --- |
| Asian - Black | -4.059 | 1.116 | 1,669 | -3.637 | 2.6345e-03 | TRUE |
| Asian - LatinX | -0.847 | 1.433 | 1,669 | -0.591 | 9.7642e-01 | FALSE |
| Asian - Other | -0.155 | 2.080 | 1,669 | -0.075 | 9.9999e-01 | FALSE |
| Asian - white | 0.723 | 1.065 | 1,669 | 0.679 | 9.6108e-01 | FALSE |
| Black - LatinX | 3.212 | 1.097 | 1,669 | 2.929 | 2.8430e-02 | TRUE |
| Black - Other | 3.904 | 1.860 | 1,669 | 2.099 | 2.2081e-01 | FALSE |
| Black - white | 4.782 | 0.522 | 1,669 | 9.158 | 1.6549e-12 | TRUE |
| LatinX - Other | 0.692 | 2.068 | 1,669 | 0.335 | 9.9730e-01 | FALSE |
| LatinX - white | 1.570 | 1.045 | 1,669 | 1.503 | 5.6073e-01 | FALSE |
| Other - white | 0.878 | 1.831 | 1,669 | 0.480 | 9.8921e-01 | FALSE |

emmip\_BiW\_Lr <- emmip(BiW\_Lout, ~ race\_eth, CIs = TRUE)  
  
emmip\_BiW\_Lr +   
 theme\_bw()+theme(text=element\_text(family= "Times New Roman"))+  
 labs(title="BiW\_L and Race/Ethnicity: Estimated Marginal Means Plot",  
 subtitle="With Confidence Intervals",  
 y="Linear Prediction (of measurement in mm)",  
 x="Levels of Race/Ethnicity")



BiW\_La\_em <- emmeans(BiW\_Lout, ~ age\_group)  
BiW\_La\_em1 <- as.data.frame(BiW\_La\_em)  
  
BiW\_La\_em

## age\_group emmean SE df lower.CL upper.CL  
## 18-36 111 0.522 1669 110 112  
## 37-54 111 0.542 1669 110 112  
## 55-72 109 1.131 1669 107 111  
##   
## Results are averaged over the levels of: gender, race\_eth   
## Confidence level used: 0.95

BiW\_La\_em1 <- BiW\_La\_em1 %>%   
 mutate(across(where(is.numeric), round, digits=3))  
  
flextable(BiW\_La\_em1) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("Estimated Marginal Means: BiW\_L and Age Group") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

**Table 14**: Estimated Marginal Means: BiW\_L and Age Group

| **age\_group** | **emmean** | **SE** | **df** | **lower.CL** | **upper.CL** |
| --- | --- | --- | --- | --- | --- |
| 18-36 | 111.473 | 0.522 | 1,669 | 110.450 | 112.497 |
| 37-54 | 110.823 | 0.542 | 1,669 | 109.760 | 111.885 |
| 55-72 | 108.722 | 1.131 | 1,669 | 106.502 | 110.941 |

BiW\_La\_em2 <- pairs(BiW\_La\_em, adjust="Tukey")  
BiW\_La\_em3 <- as.data.frame(BiW\_La\_em2)  
  
BiW\_La\_em3$signif <- with(BiW\_La\_em3, ifelse(p.value < 0.05, 'TRUE', 'FALSE'))  
BiW\_La\_em3$p.value <- formatC(BiW\_La\_em3$p.value, format = "e")  
  
BiW\_La\_em2

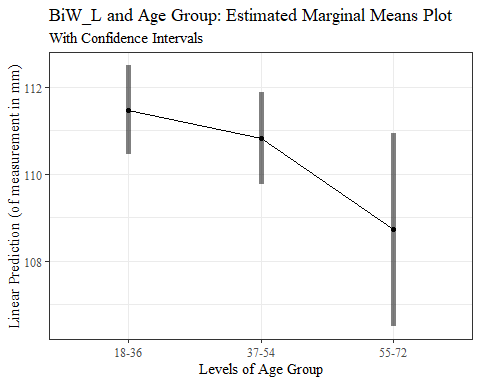
## contrast estimate SE df t.ratio p.value  
## (18-36) - (37-54) 0.651 0.463 1669 1.405 0.3386  
## (18-36) - (55-72) 2.752 1.121 1669 2.455 0.0377  
## (37-54) - (55-72) 2.101 1.125 1669 1.868 0.1483  
##   
## Results are averaged over the levels of: gender, race\_eth   
## P value adjustment: tukey method for comparing a family of 3 estimates

BiW\_La\_em3 <- BiW\_La\_em3 %>%   
 mutate(across(where(is.numeric), round, digits=3))  
  
flextable(BiW\_La\_em3) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("Tukey Pairwise Comparisons: BiW\_L and Age Group") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

**Table** **15**: Tukey Pairwise Comparisons: BiW\_L and Age Group

| **contrast** | **estimate** | **SE** | **df** | **t.ratio** | **p.value** | **signif** |
| --- | --- | --- | --- | --- | --- | --- |
| (18-36) - (37-54) | 0.651 | 0.463 | 1,669 | 1.405 | 3.3859e-01 | FALSE |
| (18-36) - (55-72) | 2.752 | 1.121 | 1,669 | 2.455 | 3.7701e-02 | TRUE |
| (37-54) - (55-72) | 2.101 | 1.125 | 1,669 | 1.868 | 1.4830e-01 | FALSE |

emmip\_BiW\_La <- emmip(BiW\_Lout, ~ age\_group, CIs = TRUE)  
  
emmip\_BiW\_La +   
 theme\_bw()+theme(text=element\_text(family= "Times New Roman"))+  
 labs(title="BiW\_L and Age Group: Estimated Marginal Means Plot",  
 subtitle="With Confidence Intervals",  
 y="Linear Prediction (of measurement in mm)",  
 x="Levels of Age Group")



BiW\_Cout <- aov(BiW\_C ~ gender+race\_eth+age\_group, data=chosen\_nona1)  
summary(BiW\_Cout)

## Df Sum Sq Mean Sq F value Pr(>F)   
## gender 1 29716 29716 210.081 < 2e-16 \*\*\*  
## race\_eth 4 3057 764 5.403 0.000254 \*\*\*  
## age\_group 2 466 233 1.646 0.193125   
## Residuals 1669 236079 141   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

BiW\_Cout\_data <- as.data.frame(tidy(BiW\_Cout))

BiW\_Cout\_data <- rename(BiW\_Cout\_data, f.statistic = statistic)  
BiW\_Cout\_data$signif <- with(BiW\_Cout\_data, ifelse(p.value < 0.05, 'TRUE', 'FALSE'))  
BiW\_Cout\_data$p.value <- formatC(BiW\_Cout\_data$p.value, format = "e")  
  
  
BiW\_Cout\_data <- BiW\_Cout\_data %>%   
 mutate(across(where(is.numeric), round, digits=3))  
  
#Autofit Width Table TNR  
flextable(BiW\_Cout\_data) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("BiW\_C Additive Anova Model Findings") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

**Table** **16**: BiW\_C Additive Anova Model Findings

| **term** | **df** | **sumsq** | **meansq** | **f.statistic** | **p.value** | **signif** |
| --- | --- | --- | --- | --- | --- | --- |
| gender | 1 | 29,715.818 | 29,715.818 | 210.081 | 6.2605e-45 | TRUE |
| race\_eth | 4 | 3,056.972 | 764.243 | 5.403 | 2.5361e-04 | TRUE |
| age\_group | 2 | 465.662 | 232.831 | 1.646 | 1.9312e-01 | FALSE |
| Residuals | 1,669 | 236,078.541 | 141.449 |  | NA |  |

BiW\_Cg\_em <- emmeans(BiW\_Cout, ~ gender)  
BiW\_Cg\_em1 <- as.data.frame(BiW\_Cg\_em)  
  
BiW\_Cg\_em

## gender emmean SE df lower.CL upper.CL  
## Female/Other 127 0.778 1669 126 129  
## Male 136 0.783 1669 134 137  
##   
## Results are averaged over the levels of: race\_eth, age\_group   
## Confidence level used: 0.95

BiW\_Cg\_em1 <- BiW\_Cg\_em1 %>%   
 mutate(across(where(is.numeric), round, digits=3))  
  
flextable(BiW\_Cg\_em1) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("Estimated Marginal Means: BiW\_C and Gender") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

**Table 17**: Estimated Marginal Means: BiW\_C and Gender

| **gender** | **emmean** | **SE** | **df** | **lower.CL** | **upper.CL** |
| --- | --- | --- | --- | --- | --- |
| Female/Other | 127.168 | 0.778 | 1,669 | 125.642 | 128.694 |
| Male | 135.933 | 0.783 | 1,669 | 134.397 | 137.469 |

BiW\_Cg\_em2 <- pairs(BiW\_Cg\_em, adjust="Tukey")  
BiW\_Cg\_em3 <- as.data.frame(BiW\_Cg\_em2)  
  
BiW\_Cg\_em3$signif <- with(BiW\_Cg\_em3, ifelse(p.value < 0.05, 'TRUE', 'FALSE'))  
BiW\_Cg\_em3$p.value <- formatC(BiW\_Cg\_em3$p.value, format = "e")  
  
BiW\_Cg\_em2

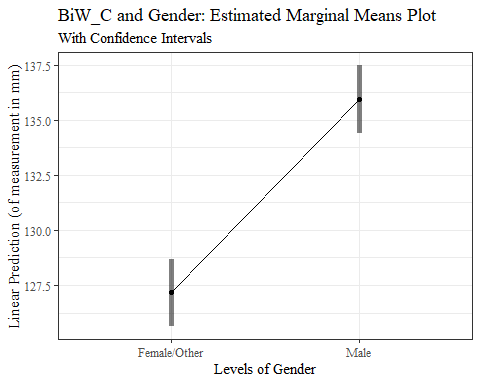
## contrast estimate SE df t.ratio p.value  
## (Female/Other) - Male -8.77 0.596 1669 -14.713 <.0001  
##   
## Results are averaged over the levels of: race\_eth, age\_group

BiW\_Cg\_em3 <- BiW\_Cg\_em3 %>%   
 mutate(across(where(is.numeric), round, digits=3))  
  
flextable(BiW\_Cg\_em3) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("Tukey Pairwise Comparisons: BiW\_C and Gender") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

**Table** **18**: Tukey Pairwise Comparisons: BiW\_C and Gender

| **contrast** | **estimate** | **SE** | **df** | **t.ratio** | **p.value** | **signif** |
| --- | --- | --- | --- | --- | --- | --- |
| (Female/Other) - Male | -8.765 | 0.596 | 1,669 | -14.713 | 3.6202e-46 | TRUE |

emmip\_BiW\_Cg <- emmip(BiW\_Cout, ~ gender, CIs = TRUE)  
  
emmip\_BiW\_Cg +   
 theme\_bw()+theme(text=element\_text(family= "Times New Roman"))+  
 labs(title="BiW\_C and Gender: Estimated Marginal Means Plot",  
 subtitle="With Confidence Intervals",  
 y="Linear Prediction (of measurement in mm)",  
 x="Levels of Gender")



BiW\_Cr\_em <- emmeans(BiW\_Cout, ~ race\_eth)  
BiW\_Cr\_em1 <- as.data.frame(BiW\_Cr\_em)  
  
BiW\_Cr\_em

## race\_eth emmean SE df lower.CL upper.CL  
## Asian 127 1.395 1669 124 130  
## Black 134 0.693 1669 132 135  
## LatinX 133 1.361 1669 130 135  
## Other 132 2.346 1669 127 136  
## white 132 0.557 1669 131 134  
##   
## Results are averaged over the levels of: gender, age\_group   
## Confidence level used: 0.95

BiW\_Cr\_em1 <- BiW\_Cr\_em1 %>%   
 mutate(across(where(is.numeric), round, digits=3))  
  
  
flextable(BiW\_Cr\_em1) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("Estimated Marginal Means: BiW\_C and Race/Ethnicity") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

**Table 19**: Estimated Marginal Means: BiW\_C and Race/Ethnicity

| **race\_eth** | **emmean** | **SE** | **df** | **lower.CL** | **upper.CL** |
| --- | --- | --- | --- | --- | --- |
| Asian | 127.082 | 1.395 | 1,669 | 124.345 | 129.818 |
| Black | 133.772 | 0.693 | 1,669 | 132.412 | 135.132 |
| LatinX | 132.717 | 1.361 | 1,669 | 130.048 | 135.386 |
| Other | 131.759 | 2.346 | 1,669 | 127.157 | 136.361 |
| white | 132.422 | 0.557 | 1,669 | 131.329 | 133.515 |

BiW\_Cr\_em2 <- pairs(BiW\_Cr\_em, adjust="Tukey")  
BiW\_Cr\_em3 <- as.data.frame(BiW\_Cr\_em2)  
  
BiW\_Cr\_em3$signif <- with(BiW\_Cr\_em3, ifelse(p.value < 0.05, 'TRUE', 'FALSE'))  
BiW\_Cr\_em3$p.value <- formatC(BiW\_Cr\_em3$p.value, format = "e")  
  
BiW\_Cr\_em2

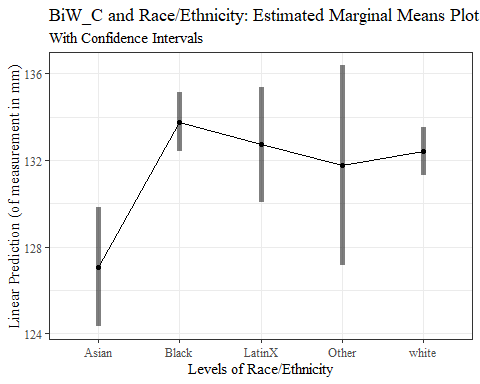
## contrast estimate SE df t.ratio p.value  
## Asian - Black -6.690 1.443 1669 -4.636 <.0001  
## Asian - LatinX -5.635 1.853 1669 -3.041 0.0202  
## Asian - Other -4.678 2.689 1669 -1.740 0.4098  
## Asian - white -5.340 1.377 1669 -3.878 0.0010  
## Black - LatinX 1.055 1.418 1669 0.744 0.9460  
## Black - Other 2.013 2.404 1669 0.837 0.9190  
## Black - white 1.350 0.675 1669 2.000 0.2661  
## LatinX - Other 0.958 2.674 1669 0.358 0.9965  
## LatinX - white 0.295 1.351 1669 0.219 0.9995  
## Other - white -0.662 2.367 1669 -0.280 0.9987  
##   
## Results are averaged over the levels of: gender, age\_group   
## P value adjustment: tukey method for comparing a family of 5 estimates

BiW\_Cr\_em3 <- BiW\_Cr\_em3 %>%   
 mutate(across(where(is.numeric), round, digits=3))  
  
flextable(BiW\_Cr\_em3) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("Tukey Pairwise Comparisons: BiW\_C and Race/Ethnicity") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

**Table** **20**: Tukey Pairwise Comparisons: BiW\_C and Race/Ethnicity

| **contrast** | **estimate** | **SE** | **df** | **t.ratio** | **p.value** | **signif** |
| --- | --- | --- | --- | --- | --- | --- |
| Asian - Black | -6.690 | 1.443 | 1,669 | -4.636 | 3.7629e-05 | TRUE |
| Asian - LatinX | -5.635 | 1.853 | 1,669 | -3.041 | 2.0224e-02 | TRUE |
| Asian - Other | -4.678 | 2.689 | 1,669 | -1.740 | 4.0984e-01 | FALSE |
| Asian - white | -5.340 | 1.377 | 1,669 | -3.878 | 1.0340e-03 | TRUE |
| Black - LatinX | 1.055 | 1.418 | 1,669 | 0.744 | 9.4605e-01 | FALSE |
| Black - Other | 2.013 | 2.404 | 1,669 | 0.837 | 9.1905e-01 | FALSE |
| Black - white | 1.350 | 0.675 | 1,669 | 2.000 | 2.6613e-01 | FALSE |
| LatinX - Other | 0.958 | 2.674 | 1,669 | 0.358 | 9.9648e-01 | FALSE |
| LatinX - white | 0.295 | 1.351 | 1,669 | 0.219 | 9.9949e-01 | FALSE |
| Other - white | -0.662 | 2.367 | 1,669 | -0.280 | 9.9866e-01 | FALSE |

emmip\_BiW\_Cr <- emmip(BiW\_Cout, ~ race\_eth, CIs = TRUE)  
  
emmip\_BiW\_Cr +   
 theme\_bw()+theme(text=element\_text(family= "Times New Roman"))+  
 labs(title="BiW\_C and Race/Ethnicity: Estimated Marginal Means Plot",  
 subtitle="With Confidence Intervals",  
 y="Linear Prediction (of measurement in mm)",  
 x="Levels of Race/Ethnicity")



GoSub\_Cout <- aov(GoSub\_C ~ gender+race\_eth+age\_group, data=chosen\_nona1)  
summary(GoSub\_Cout)

## Df Sum Sq Mean Sq F value Pr(>F)   
## gender 1 47899 47899 293.94 < 2e-16 \*\*\*  
## race\_eth 4 10256 2564 15.73 1.2e-12 \*\*\*  
## age\_group 2 26384 13192 80.96 < 2e-16 \*\*\*  
## Residuals 1669 271970 163   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

GoSub\_Cout\_data <- as.data.frame(tidy(GoSub\_Cout))

GoSub\_Cout\_data <- rename(GoSub\_Cout\_data, f.statistic = statistic)  
GoSub\_Cout\_data$signif <- with(GoSub\_Cout\_data, ifelse(p.value < 0.05, 'TRUE', 'FALSE'))  
GoSub\_Cout\_data$p.value <- formatC(GoSub\_Cout\_data$p.value, format = "e")  
  
  
GoSub\_Cout\_data <- GoSub\_Cout\_data %>%   
 mutate(across(where(is.numeric), round, digits=3))  
  
  
#Autofit Width Table TNR  
flextable(GoSub\_Cout\_data) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("GoSub\_C Additive Anova Model Findings") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

**Table** **21**: GoSub\_C Additive Anova Model Findings

| **term** | **df** | **sumsq** | **meansq** | **f.statistic** | **p.value** | **signif** |
| --- | --- | --- | --- | --- | --- | --- |
| gender | 1 | 47,899.08 | 47,899.077 | 293.943 | 8.1271e-61 | TRUE |
| race\_eth | 4 | 10,256.44 | 2,564.109 | 15.735 | 1.2020e-12 | TRUE |
| age\_group | 2 | 26,384.41 | 13,192.205 | 80.957 | 2.7768e-34 | TRUE |
| Residuals | 1,669 | 271,970.02 | 162.954 |  | NA |  |

GoSub\_Cg\_em <- emmeans(GoSub\_Cout, ~ gender)  
GoSub\_Cg\_em1 <- as.data.frame(GoSub\_Cg\_em)  
  
GoSub\_Cg\_em

## gender emmean SE df lower.CL upper.CL  
## Female/Other 93.9 0.835 1669 92.3 95.6  
## Male 105.3 0.840 1669 103.6 106.9  
##   
## Results are averaged over the levels of: race\_eth, age\_group   
## Confidence level used: 0.95

GoSub\_Cg\_em1 <- GoSub\_Cg\_em1 %>%   
 mutate(across(where(is.numeric), round, digits=3))  
  
flextable(GoSub\_Cg\_em1) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("Estimated Marginal Means: GoSub\_C and Gender") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

**Table 22**: Estimated Marginal Means: GoSub\_C and Gender

| **gender** | **emmean** | **SE** | **df** | **lower.CL** | **upper.CL** |
| --- | --- | --- | --- | --- | --- |
| Female/Other | 93.934 | 0.835 | 1,669 | 92.296 | 95.571 |
| Male | 105.276 | 0.840 | 1,669 | 103.628 | 106.924 |

GoSub\_Cg\_em2 <- pairs(GoSub\_Cg\_em, adjust="Tukey")  
GoSub\_Cg\_em3 <- as.data.frame(GoSub\_Cg\_em2)  
  
GoSub\_Cg\_em3$signif <- with(GoSub\_Cg\_em3, ifelse(p.value < 0.05, 'TRUE', 'FALSE'))  
GoSub\_Cg\_em3$p.value <- formatC(GoSub\_Cg\_em3$p.value, format = "e")  
  
GoSub\_Cg\_em2

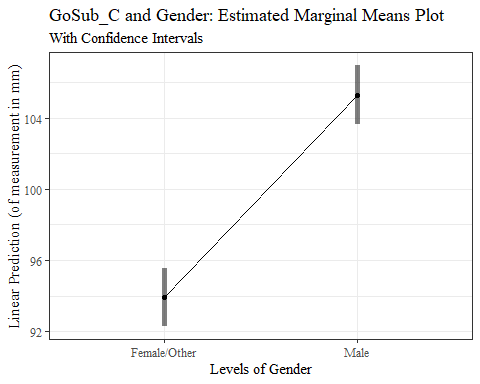
## contrast estimate SE df t.ratio p.value  
## (Female/Other) - Male -11.3 0.639 1669 -17.738 <.0001  
##   
## Results are averaged over the levels of: race\_eth, age\_group

GoSub\_Cg\_em3 <- GoSub\_Cg\_em3 %>%   
 mutate(across(where(is.numeric), round, digits=3))  
  
flextable(GoSub\_Cg\_em3) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("Tukey Pairwise Comparisons: GoSub\_C and Gender") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

**Table** **23**: Tukey Pairwise Comparisons: GoSub\_C and Gender

| **contrast** | **estimate** | **SE** | **df** | **t.ratio** | **p.value** | **signif** |
| --- | --- | --- | --- | --- | --- | --- |
| (Female/Other) - Male | -11.342 | 0.639 | 1,669 | -17.738 | 1.2457e-64 | TRUE |

emmip\_GoSub\_Cg <- emmip(GoSub\_Cout, ~ gender, CIs = TRUE)  
  
emmip\_GoSub\_Cg +   
 theme\_bw()+theme(text=element\_text(family= "Times New Roman"))+  
 labs(title="GoSub\_C and Gender: Estimated Marginal Means Plot",  
 subtitle="With Confidence Intervals",  
 y="Linear Prediction (of measurement in mm)",  
 x="Levels of Gender")



GoSub\_Cr\_em <- emmeans(GoSub\_Cout, ~ race\_eth)  
GoSub\_Cr\_em1 <- as.data.frame(GoSub\_Cr\_em)  
  
GoSub\_Cr\_em

## race\_eth emmean SE df lower.CL upper.CL  
## Asian 97.6 1.498 1669 94.7 101  
## Black 104.3 0.744 1669 102.8 106  
## LatinX 99.7 1.461 1669 96.9 103  
## Other 96.5 2.518 1669 91.6 101  
## white 99.9 0.598 1669 98.7 101  
##   
## Results are averaged over the levels of: gender, age\_group   
## Confidence level used: 0.95

GoSub\_Cr\_em1 <- GoSub\_Cr\_em1 %>%   
 mutate(across(where(is.numeric), round, digits=3))  
  
flextable(GoSub\_Cr\_em1) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("Estimated Marginal Means: GoSub\_C and Race/Ethnicity") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

**Table 24**: Estimated Marginal Means: GoSub\_C and Race/Ethnicity

| **race\_eth** | **emmean** | **SE** | **df** | **lower.CL** | **upper.CL** |
| --- | --- | --- | --- | --- | --- |
| Asian | 97.634 | 1.498 | 1,669 | 94.697 | 100.571 |
| Black | 104.278 | 0.744 | 1,669 | 102.818 | 105.738 |
| LatinX | 99.732 | 1.461 | 1,669 | 96.867 | 102.597 |
| Other | 96.497 | 2.518 | 1,669 | 91.557 | 101.436 |
| white | 99.883 | 0.598 | 1,669 | 98.710 | 101.057 |

GoSub\_Cr\_em2 <- pairs(GoSub\_Cr\_em, adjust="Tukey")  
GoSub\_Cr\_em3 <- as.data.frame(GoSub\_Cr\_em2)  
  
GoSub\_Cr\_em3$signif <- with(GoSub\_Cr\_em3, ifelse(p.value < 0.05, 'TRUE', 'FALSE'))  
GoSub\_Cr\_em3$p.value <- formatC(GoSub\_Cr\_em3$p.value, format = "e")  
  
GoSub\_Cr\_em2

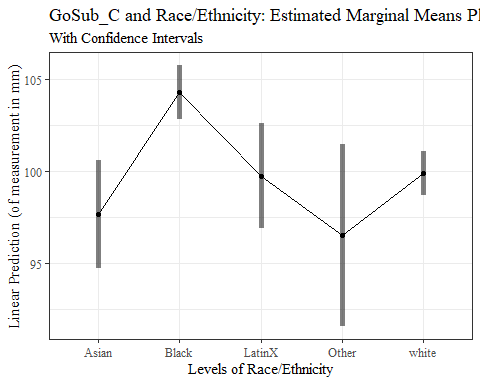
## contrast estimate SE df t.ratio p.value  
## Asian - Black -6.644 1.549 1669 -4.289 0.0002  
## Asian - LatinX -2.098 1.989 1669 -1.055 0.8296  
## Asian - Other 1.137 2.886 1669 0.394 0.9949  
## Asian - white -2.249 1.478 1669 -1.522 0.5483  
## Black - LatinX 4.546 1.522 1669 2.987 0.0238  
## Black - Other 7.781 2.581 1669 3.015 0.0219  
## Black - white 4.395 0.725 1669 6.066 <.0001  
## LatinX - Other 3.235 2.870 1669 1.127 0.7922  
## LatinX - white -0.151 1.450 1669 -0.104 1.0000  
## Other - white -3.387 2.541 1669 -1.333 0.6707  
##   
## Results are averaged over the levels of: gender, age\_group   
## P value adjustment: tukey method for comparing a family of 5 estimates

GoSub\_Cr\_em3 <- GoSub\_Cr\_em3 %>%   
 mutate(across(where(is.numeric), round, digits=3))  
  
  
flextable(GoSub\_Cr\_em3) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("Tukey Pairwise Comparisons: GoSub\_C and Race/Ethnicity") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

**Table** **25**: Tukey Pairwise Comparisons: GoSub\_C and Race/Ethnicity

| **contrast** | **estimate** | **SE** | **df** | **t.ratio** | **p.value** | **signif** |
| --- | --- | --- | --- | --- | --- | --- |
| Asian - Black | -6.644 | 1.549 | 1,669 | -4.289 | 1.8392e-04 | TRUE |
| Asian - LatinX | -2.098 | 1.989 | 1,669 | -1.055 | 8.2957e-01 | FALSE |
| Asian - Other | 1.137 | 2.886 | 1,669 | 0.394 | 9.9491e-01 | FALSE |
| Asian - white | -2.249 | 1.478 | 1,669 | -1.522 | 5.4826e-01 | FALSE |
| Black - LatinX | 4.546 | 1.522 | 1,669 | 2.987 | 2.3847e-02 | TRUE |
| Black - Other | 7.781 | 2.581 | 1,669 | 3.015 | 2.1891e-02 | TRUE |
| Black - white | 4.395 | 0.725 | 1,669 | 6.066 | 1.6216e-08 | TRUE |
| LatinX - Other | 3.235 | 2.870 | 1,669 | 1.127 | 7.9217e-01 | FALSE |
| LatinX - white | -0.151 | 1.450 | 1,669 | -0.104 | 9.9997e-01 | FALSE |
| Other - white | -3.387 | 2.541 | 1,669 | -1.333 | 6.7065e-01 | FALSE |

emmip\_GoSub\_Cr <- emmip(GoSub\_Cout, ~ race\_eth, CIs = TRUE)  
  
emmip\_GoSub\_Cr +   
 theme\_bw()+theme(text=element\_text(family= "Times New Roman"))+  
 labs(title="GoSub\_C and Race/Ethnicity: Estimated Marginal Means Plot",  
 subtitle="With Confidence Intervals",  
 y="Linear Prediction (of measurement in mm)",  
 x="Levels of Race/Ethnicity")



GoSub\_Ca\_em <- emmeans(GoSub\_Cout, ~ age\_group)  
GoSub\_Ca\_em1 <- as.data.frame(GoSub\_Ca\_em)  
  
GoSub\_Ca\_em

## age\_group emmean SE df lower.CL upper.CL  
## 18-36 93.6 0.724 1669 92.2 95.1  
## 37-54 101.3 0.752 1669 99.9 102.8  
## 55-72 103.8 1.570 1669 100.7 106.9  
##   
## Results are averaged over the levels of: gender, race\_eth   
## Confidence level used: 0.95

GoSub\_Ca\_em1 <- GoSub\_Ca\_em1 %>%   
 mutate(across(where(is.numeric), round, digits=3))  
  
flextable(GoSub\_Ca\_em1) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("Estimated Marginal Means: GoSub\_C and Age Group") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

**Table 26**: Estimated Marginal Means: GoSub\_C and Age Group

| **age\_group** | **emmean** | **SE** | **df** | **lower.CL** | **upper.CL** |
| --- | --- | --- | --- | --- | --- |
| 18-36 | 93.638 | 0.724 | 1,669 | 92.218 | 95.058 |
| 37-54 | 101.347 | 0.752 | 1,669 | 99.873 | 102.821 |
| 55-72 | 103.829 | 1.570 | 1,669 | 100.749 | 106.909 |

GoSub\_Ca\_em2 <- pairs(GoSub\_Ca\_em, adjust="Tukey")  
GoSub\_Ca\_em3 <- as.data.frame(GoSub\_Ca\_em2)  
  
GoSub\_Ca\_em3$signif <- with(GoSub\_Ca\_em3, ifelse(p.value < 0.05, 'TRUE', 'FALSE'))  
GoSub\_Ca\_em3$p.value <- formatC(GoSub\_Ca\_em3$p.value, format = "e")  
  
GoSub\_Ca\_em2

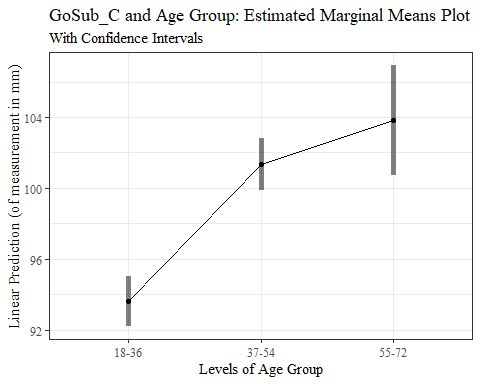
## contrast estimate SE df t.ratio p.value  
## (18-36) - (37-54) -7.71 0.643 1669 -11.991 <.0001  
## (18-36) - (55-72) -10.19 1.555 1669 -6.552 <.0001  
## (37-54) - (55-72) -2.48 1.561 1669 -1.590 0.2502  
##   
## Results are averaged over the levels of: gender, race\_eth   
## P value adjustment: tukey method for comparing a family of 3 estimates

GoSub\_Ca\_em3 <- GoSub\_Ca\_em3 %>%   
 mutate(across(where(is.numeric), round, digits=3))  
  
flextable(GoSub\_Ca\_em3) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("Tukey Pairwise Comparisons: GoSub\_C and Age Group") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

**Table** **27**: Tukey Pairwise Comparisons: GoSub\_C and Age Group

| **contrast** | **estimate** | **SE** | **df** | **t.ratio** | **p.value** | **signif** |
| --- | --- | --- | --- | --- | --- | --- |
| (18-36) - (37-54) | -7.709 | 0.643 | 1,669 | -11.991 | 1.6044e-12 | TRUE |
| (18-36) - (55-72) | -10.191 | 1.555 | 1,669 | -6.552 | 2.2804e-10 | TRUE |
| (37-54) - (55-72) | -2.482 | 1.561 | 1,669 | -1.590 | 2.5018e-01 | FALSE |

emmip\_GoSub\_Ca <- emmip(GoSub\_Cout, ~ age\_group, CIs = TRUE)  
  
emmip\_GoSub\_Ca +   
 theme\_bw()+theme(text=element\_text(family= "Times New Roman"))+  
 labs(title="GoSub\_C and Age Group: Estimated Marginal Means Plot",  
 subtitle="With Confidence Intervals",  
 y="Linear Prediction (of measurement in mm)",  
 x="Levels of Age Group")



NRB\_Lout <- aov(NRB\_L ~ gender+race\_eth+age\_group, data=chosen\_nona1)  
summary(NRB\_Lout)

## Df Sum Sq Mean Sq F value Pr(>F)   
## gender 1 181 181.0 8.728 0.00318 \*\*   
## race\_eth 4 1890 472.5 22.787 < 2e-16 \*\*\*  
## age\_group 2 88 43.9 2.119 0.12051   
## Residuals 1669 34605 20.7   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

NRB\_Lout\_data <- as.data.frame(tidy(NRB\_Lout))

NRB\_Lout\_data <- rename(NRB\_Lout\_data, f.statistic = statistic)  
NRB\_Lout\_data$signif <- with(NRB\_Lout\_data, ifelse(p.value < 0.05, 'TRUE', 'FALSE'))  
NRB\_Lout\_data$p.value <- formatC(NRB\_Lout\_data$p.value, format = "e")  
  
NRB\_Lout\_data <- NRB\_Lout\_data %>%   
 mutate(across(where(is.numeric), round, digits=3))  
  
#Autofit Width Table TNR  
flextable(NRB\_Lout\_data) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("NRB\_L Additive Anova Model Findings") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

**Table** **28**: NRB\_L Additive Anova Model Findings

| **term** | **df** | **sumsq** | **meansq** | **f.statistic** | **p.value** | **signif** |
| --- | --- | --- | --- | --- | --- | --- |
| gender | 1 | 180.963 | 180.963 | 8.728 | 3.1777e-03 | TRUE |
| race\_eth | 4 | 1,889.826 | 472.456 | 22.787 | 2.3709e-18 | TRUE |
| age\_group | 2 | 87.860 | 43.930 | 2.119 | 1.2051e-01 | FALSE |
| Residuals | 1,669 | 34,605.004 | 20.734 |  | NA |  |

NRB\_Lg\_em <- emmeans(NRB\_Lout, ~ gender)  
NRB\_Lg\_em1 <- as.data.frame(NRB\_Lg\_em)  
  
NRB\_Lg\_em

## gender emmean SE df lower.CL upper.CL  
## Female/Other 18.2 0.298 1669 17.6 18.8  
## Male 17.5 0.300 1669 16.9 18.1  
##   
## Results are averaged over the levels of: race\_eth, age\_group   
## Confidence level used: 0.95

NRB\_Lg\_em1 <- NRB\_Lg\_em1 %>%   
 mutate(across(where(is.numeric), round, digits=3))  
  
flextable(NRB\_Lg\_em1) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("Estimated Marginal Means: NRB\_L and Gender") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

**Table 29**: Estimated Marginal Means: NRB\_L and Gender

| **gender** | **emmean** | **SE** | **df** | **lower.CL** | **upper.CL** |
| --- | --- | --- | --- | --- | --- |
| Female/Other | 18.209 | 0.298 | 1,669 | 17.625 | 18.793 |
| Male | 17.493 | 0.300 | 1,669 | 16.905 | 18.081 |

NRB\_Lg\_em2 <- pairs(NRB\_Lg\_em, adjust="Tukey")  
NRB\_Lg\_em3 <- as.data.frame(NRB\_Lg\_em2)  
  
NRB\_Lg\_em3$signif <- with(NRB\_Lg\_em3, ifelse(p.value < 0.05, 'TRUE', 'FALSE'))  
NRB\_Lg\_em3$p.value <- formatC(NRB\_Lg\_em3$p.value, format = "e")  
  
NRB\_Lg\_em2

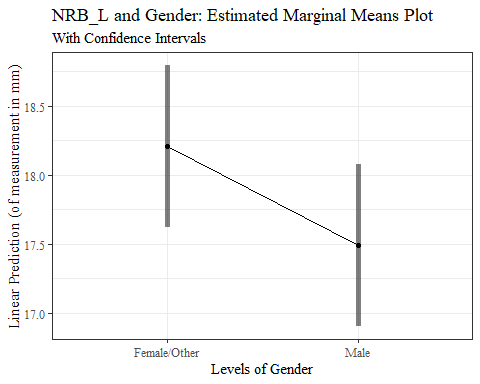
## contrast estimate SE df t.ratio p.value  
## (Female/Other) - Male 0.716 0.228 1669 3.139 0.0017  
##   
## Results are averaged over the levels of: race\_eth, age\_group

NRB\_Lg\_em3 <- NRB\_Lg\_em3 %>%   
 mutate(across(where(is.numeric), round, digits=3))  
  
flextable(NRB\_Lg\_em3) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("Tukey Pairwise Comparisons: NRB\_L and Gender") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

**Table** **30**: Tukey Pairwise Comparisons: NRB\_L and Gender

| **contrast** | **estimate** | **SE** | **df** | **t.ratio** | **p.value** | **signif** |
| --- | --- | --- | --- | --- | --- | --- |
| (Female/Other) - Male | 0.716 | 0.228 | 1,669 | 3.139 | 1.7239e-03 | TRUE |

emmip\_NRB\_Lg <- emmip(NRB\_Lout, ~ gender, CIs = TRUE)  
  
emmip\_NRB\_Lg +   
 theme\_bw()+theme(text=element\_text(family= "Times New Roman"))+  
 labs(title="NRB\_L and Gender: Estimated Marginal Means Plot",  
 subtitle="With Confidence Intervals",  
 y="Linear Prediction (of measurement in mm)",  
 x="Levels of Gender")



NRB\_Lr\_em <- emmeans(NRB\_Lout, ~ race\_eth)  
NRB\_Lr\_em1 <- as.data.frame(NRB\_Lr\_em)  
  
NRB\_Lr\_em

## race\_eth emmean SE df lower.CL upper.CL  
## Asian 16.7 0.534 1669 15.7 17.7  
## Black 19.4 0.265 1669 18.9 19.9  
## LatinX 17.4 0.521 1669 16.4 18.4  
## Other 18.8 0.898 1669 17.1 20.6  
## white 16.9 0.213 1669 16.5 17.4  
##   
## Results are averaged over the levels of: gender, age\_group   
## Confidence level used: 0.95

NRB\_Lr\_em1 <- NRB\_Lr\_em1 %>%   
 mutate(across(where(is.numeric), round, digits=3))  
  
flextable(NRB\_Lr\_em1) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("Estimated Marginal Means: NRB\_L and Race/Ethnicity") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

**Table 31**: Estimated Marginal Means: NRB\_L and Race/Ethnicity

| **race\_eth** | **emmean** | **SE** | **df** | **lower.CL** | **upper.CL** |
| --- | --- | --- | --- | --- | --- |
| Asian | 16.698 | 0.534 | 1,669 | 15.650 | 17.746 |
| Black | 19.374 | 0.265 | 1,669 | 18.854 | 19.895 |
| LatinX | 17.398 | 0.521 | 1,669 | 16.376 | 18.420 |
| Other | 18.839 | 0.898 | 1,669 | 17.077 | 20.601 |
| white | 16.944 | 0.213 | 1,669 | 16.526 | 17.363 |

NRB\_Lr\_em2 <- pairs(NRB\_Lr\_em, adjust="Tukey")  
NRB\_Lr\_em3 <- as.data.frame(NRB\_Lr\_em2)  
  
NRB\_Lr\_em3$signif <- with(NRB\_Lr\_em3, ifelse(p.value < 0.05, 'TRUE', 'FALSE'))  
NRB\_Lr\_em3$p.value <- formatC(NRB\_Lr\_em3$p.value, format = "e")  
  
NRB\_Lr\_em2

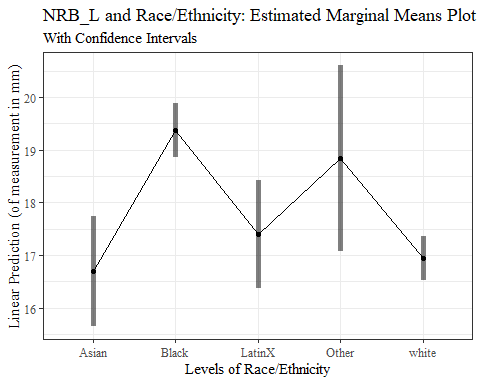
## contrast estimate SE df t.ratio p.value  
## Asian - Black -2.676 0.553 1669 -4.844 <.0001  
## Asian - LatinX -0.700 0.709 1669 -0.987 0.8613  
## Asian - Other -2.141 1.029 1669 -2.080 0.2292  
## Asian - white -0.246 0.527 1669 -0.467 0.9902  
## Black - LatinX 1.976 0.543 1669 3.641 0.0026  
## Black - Other 0.535 0.921 1669 0.581 0.9778  
## Black - white 2.430 0.258 1669 9.403 <.0001  
## LatinX - Other -1.441 1.024 1669 -1.408 0.6229  
## LatinX - white 0.454 0.517 1669 0.878 0.9052  
## Other - white 1.895 0.906 1669 2.091 0.2245  
##   
## Results are averaged over the levels of: gender, age\_group   
## P value adjustment: tukey method for comparing a family of 5 estimates

NRB\_Lr\_em3 <- NRB\_Lr\_em3 %>%   
 mutate(across(where(is.numeric), round, digits=3))  
  
flextable(NRB\_Lr\_em3) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("Tukey Pairwise Comparisons: NRB\_L and Race/Ethnicity") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

**Table** **32**: Tukey Pairwise Comparisons: NRB\_L and Race/Ethnicity

| **contrast** | **estimate** | **SE** | **df** | **t.ratio** | **p.value** | **signif** |
| --- | --- | --- | --- | --- | --- | --- |
| Asian - Black | -2.676 | 0.553 | 1,669 | -4.844 | 1.3729e-05 | TRUE |
| Asian - LatinX | -0.700 | 0.709 | 1,669 | -0.987 | 8.6129e-01 | FALSE |
| Asian - Other | -2.141 | 1.029 | 1,669 | -2.080 | 2.2920e-01 | FALSE |
| Asian - white | -0.246 | 0.527 | 1,669 | -0.467 | 9.9023e-01 | FALSE |
| Black - LatinX | 1.976 | 0.543 | 1,669 | 3.641 | 2.5953e-03 | TRUE |
| Black - Other | 0.535 | 0.921 | 1,669 | 0.581 | 9.7783e-01 | FALSE |
| Black - white | 2.430 | 0.258 | 1,669 | 9.403 | 1.6522e-12 | TRUE |
| LatinX - Other | -1.441 | 1.024 | 1,669 | -1.408 | 6.2287e-01 | FALSE |
| LatinX - white | 0.454 | 0.517 | 1,669 | 0.878 | 9.0515e-01 | FALSE |
| Other - white | 1.895 | 0.906 | 1,669 | 2.091 | 2.2445e-01 | FALSE |

emmip\_NRB\_Lr <- emmip(NRB\_Lout, ~ race\_eth, CIs = TRUE)  
  
emmip\_NRB\_Lr +   
 theme\_bw()+theme(text=element\_text(family= "Times New Roman"))+  
 labs(title="NRB\_L and Race/Ethnicity: Estimated Marginal Means Plot",  
 subtitle="With Confidence Intervals",  
 y="Linear Prediction (of measurement in mm)",  
 x="Levels of Race/Ethnicity")



ProS\_Lout <- aov(ProS\_L ~ gender+race\_eth+age\_group, data=chosen\_nona1)  
summary(ProS\_Lout)

## Df Sum Sq Mean Sq F value Pr(>F)   
## gender 1 425 425.5 76.77 < 2e-16 \*\*\*  
## race\_eth 4 1001 250.3 45.15 < 2e-16 \*\*\*  
## age\_group 2 374 186.9 33.71 4.44e-15 \*\*\*  
## Residuals 1669 9251 5.5   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

ProS\_Lout\_data <- as.data.frame(tidy(ProS\_Lout))

ProS\_Lout\_data <- rename(ProS\_Lout\_data, f.statistic = statistic)  
ProS\_Lout\_data$signif <- with(ProS\_Lout\_data, ifelse(p.value < 0.05, 'TRUE', 'FALSE'))  
ProS\_Lout\_data$p.value <- formatC(ProS\_Lout\_data$p.value, format = "e")  
  
  
ProS\_Lout\_data <- ProS\_Lout\_data %>%   
 mutate(across(where(is.numeric), round, digits=3))  
  
#Autofit Width Table TNR  
flextable(ProS\_Lout\_data) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("ProS\_L Additive Anova Model Findings") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

**Table** **33**: ProS\_L Additive Anova Model Findings

| **term** | **df** | **sumsq** | **meansq** | **f.statistic** | **p.value** | **signif** |
| --- | --- | --- | --- | --- | --- | --- |
| gender | 1 | 425.486 | 425.486 | 76.765 | 4.6378e-18 | TRUE |
| race\_eth | 4 | 1,001.098 | 250.275 | 45.154 | 4.7524e-36 | TRUE |
| age\_group | 2 | 373.708 | 186.854 | 33.712 | 4.4386e-15 | TRUE |
| Residuals | 1,669 | 9,250.821 | 5.543 |  | NA |  |

ProS\_Lg\_em <- emmeans(ProS\_Lout, ~ gender)  
ProS\_Lg\_em1 <- as.data.frame(ProS\_Lg\_em)  
  
ProS\_Lg\_em

## gender emmean SE df lower.CL upper.CL  
## Female/Other 18.1 0.154 1669 17.8 18.4  
## Male 19.3 0.155 1669 19.0 19.6  
##   
## Results are averaged over the levels of: race\_eth, age\_group   
## Confidence level used: 0.95

ProS\_Lg\_em1 <- ProS\_Lg\_em1 %>%   
 mutate(across(where(is.numeric), round, digits=3))  
  
flextable(ProS\_Lg\_em1) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("Estimated Marginal Means: ProS\_L and Gender") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

**Table 34**: Estimated Marginal Means: ProS\_L and Gender

| **gender** | **emmean** | **SE** | **df** | **lower.CL** | **upper.CL** |
| --- | --- | --- | --- | --- | --- |
| Female/Other | 18.097 | 0.154 | 1,669 | 17.795 | 18.399 |
| Male | 19.263 | 0.155 | 1,669 | 18.959 | 19.567 |

ProS\_Lg\_em2 <- pairs(ProS\_Lg\_em, adjust="Tukey")  
ProS\_Lg\_em3 <- as.data.frame(ProS\_Lg\_em2)  
  
ProS\_Lg\_em3$signif <- with(ProS\_Lg\_em3, ifelse(p.value < 0.05, 'TRUE', 'FALSE'))  
ProS\_Lg\_em3$p.value <- formatC(ProS\_Lg\_em3$p.value, format = "e")  
  
ProS\_Lg\_em2

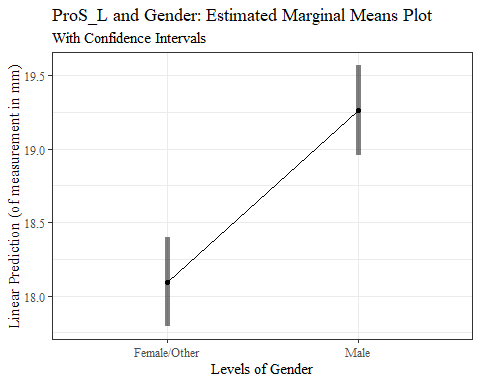
## contrast estimate SE df t.ratio p.value  
## (Female/Other) - Male -1.17 0.118 1669 -9.886 <.0001  
##   
## Results are averaged over the levels of: race\_eth, age\_group

ProS\_Lg\_em3 <- ProS\_Lg\_em3 %>%   
 mutate(across(where(is.numeric), round, digits=3))  
  
flextable(ProS\_Lg\_em3) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("Tukey Pairwise Comparisons: ProS\_L and Gender") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

**Table** **35**: Tukey Pairwise Comparisons: ProS\_L and Gender

| **contrast** | **estimate** | **SE** | **df** | **t.ratio** | **p.value** | **signif** |
| --- | --- | --- | --- | --- | --- | --- |
| (Female/Other) - Male | -1.166 | 0.118 | 1,669 | -9.886 | 1.9456e-22 | TRUE |

emmip\_ProS\_Lg <- emmip(ProS\_Lout, ~ gender, CIs = TRUE)  
  
emmip\_ProS\_Lg +   
 theme\_bw()+theme(text=element\_text(family= "Times New Roman"))+  
 labs(title="ProS\_L and Gender: Estimated Marginal Means Plot",  
 subtitle="With Confidence Intervals",  
 y="Linear Prediction (of measurement in mm)",  
 x="Levels of Gender")



ProS\_Lr\_em <- emmeans(ProS\_Lout, ~ race\_eth)  
ProS\_Lr\_em1 <- as.data.frame(ProS\_Lr\_em)  
  
ProS\_Lr\_em

## race\_eth emmean SE df lower.CL upper.CL  
## Asian 18.3 0.276 1669 17.8 18.9  
## Black 18.3 0.137 1669 18.0 18.6  
## LatinX 18.9 0.269 1669 18.4 19.4  
## Other 17.9 0.464 1669 17.0 18.8  
## white 20.0 0.110 1669 19.8 20.2  
##   
## Results are averaged over the levels of: gender, age\_group   
## Confidence level used: 0.95

ProS\_Lr\_em1 <- ProS\_Lr\_em1 %>%   
 mutate(across(where(is.numeric), round, digits=3))  
  
flextable(ProS\_Lr\_em1) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("Estimated Marginal Means: ProS\_L and Race/Ethnicity") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

**Table 36**: Estimated Marginal Means: ProS\_L and Race/Ethnicity

| **race\_eth** | **emmean** | **SE** | **df** | **lower.CL** | **upper.CL** |
| --- | --- | --- | --- | --- | --- |
| Asian | 18.336 | 0.276 | 1,669 | 17.794 | 18.878 |
| Black | 18.313 | 0.137 | 1,669 | 18.044 | 18.582 |
| LatinX | 18.892 | 0.269 | 1,669 | 18.363 | 19.420 |
| Other | 17.872 | 0.464 | 1,669 | 16.961 | 18.783 |
| white | 19.985 | 0.110 | 1,669 | 19.768 | 20.201 |

ProS\_Lr\_em2 <- pairs(ProS\_Lr\_em, adjust="Tukey")  
ProS\_Lr\_em3 <- as.data.frame(ProS\_Lr\_em2)  
  
ProS\_Lr\_em3$signif <- with(ProS\_Lr\_em3, ifelse(p.value < 0.05, 'TRUE', 'FALSE'))  
ProS\_Lr\_em3$p.value <- formatC(ProS\_Lr\_em3$p.value, format = "e")  
  
ProS\_Lr\_em2

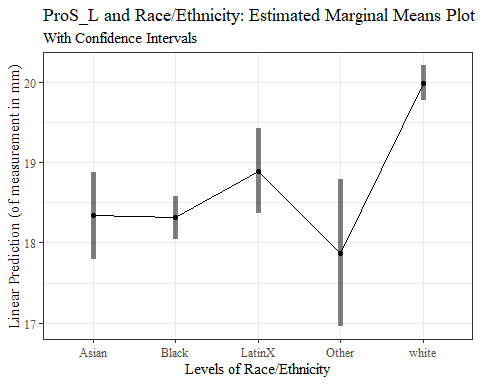
## contrast estimate SE df t.ratio p.value  
## Asian - Black 0.0231 0.286 1669 0.081 1.0000  
## Asian - LatinX -0.5556 0.367 1669 -1.515 0.5531  
## Asian - Other 0.4640 0.532 1669 0.872 0.9073  
## Asian - white -1.6486 0.273 1669 -6.049 <.0001  
## Black - LatinX -0.5787 0.281 1669 -2.062 0.2373  
## Black - Other 0.4409 0.476 1669 0.926 0.8867  
## Black - white -1.6717 0.134 1669 -12.510 <.0001  
## LatinX - Other 1.0196 0.529 1669 1.926 0.3037  
## LatinX - white -1.0930 0.267 1669 -4.088 0.0004  
## Other - white -2.1126 0.469 1669 -4.508 0.0001  
##   
## Results are averaged over the levels of: gender, age\_group   
## P value adjustment: tukey method for comparing a family of 5 estimates

ProS\_Lr\_em3 <- ProS\_Lr\_em3 %>%   
 mutate(across(where(is.numeric), round, digits=3))  
  
flextable(ProS\_Lr\_em3) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("Tukey Pairwise Comparisons: ProS\_L and Race/Ethnicity") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

**Table** **37**: Tukey Pairwise Comparisons: ProS\_L and Race/Ethnicity

| **contrast** | **estimate** | **SE** | **df** | **t.ratio** | **p.value** | **signif** |
| --- | --- | --- | --- | --- | --- | --- |
| Asian - Black | 0.023 | 0.286 | 1,669 | 0.081 | 9.9999e-01 | FALSE |
| Asian - LatinX | -0.556 | 0.367 | 1,669 | -1.515 | 5.5305e-01 | FALSE |
| Asian - Other | 0.464 | 0.532 | 1,669 | 0.872 | 9.0725e-01 | FALSE |
| Asian - white | -1.649 | 0.273 | 1,669 | -6.049 | 1.7970e-08 | TRUE |
| Black - LatinX | -0.579 | 0.281 | 1,669 | -2.062 | 2.3735e-01 | FALSE |
| Black - Other | 0.441 | 0.476 | 1,669 | 0.926 | 8.8671e-01 | FALSE |
| Black - white | -1.672 | 0.134 | 1,669 | -12.510 | 1.6044e-12 | TRUE |
| LatinX - Other | 1.020 | 0.529 | 1,669 | 1.926 | 3.0373e-01 | FALSE |
| LatinX - white | -1.093 | 0.267 | 1,669 | -4.088 | 4.3766e-04 | TRUE |
| Other - white | -2.113 | 0.469 | 1,669 | -4.508 | 6.8428e-05 | TRUE |

emmip\_ProS\_Lr <- emmip(ProS\_Lout, ~ race\_eth, CIs = TRUE)  
  
emmip\_ProS\_Lr +   
 theme\_bw()+theme(text=element\_text(family= "Times New Roman"))+  
 labs(title="ProS\_L and Race/Ethnicity: Estimated Marginal Means Plot",  
 subtitle="With Confidence Intervals",  
 y="Linear Prediction (of measurement in mm)",  
 x="Levels of Race/Ethnicity")



ProS\_La\_em <- emmeans(ProS\_Lout, ~ age\_group)  
ProS\_La\_em1 <- as.data.frame(ProS\_La\_em)  
  
ProS\_La\_em

## age\_group emmean SE df lower.CL upper.CL  
## 18-36 18 0.134 1669 17.8 18.3  
## 37-54 19 0.139 1669 18.7 19.2  
## 55-72 19 0.290 1669 18.5 19.6  
##   
## Results are averaged over the levels of: gender, race\_eth   
## Confidence level used: 0.95

ProS\_La\_em1 <- ProS\_La\_em1 %>%   
 mutate(across(where(is.numeric), round, digits=3))  
  
flextable(ProS\_La\_em1) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("Estimated Marginal Means: ProS\_L and Age Group") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

**Table 38**: Estimated Marginal Means: ProS\_L and Age Group

| **age\_group** | **emmean** | **SE** | **df** | **lower.CL** | **upper.CL** |
| --- | --- | --- | --- | --- | --- |
| 18-36 | 18.028 | 0.134 | 1,669 | 17.766 | 18.290 |
| 37-54 | 18.973 | 0.139 | 1,669 | 18.701 | 19.245 |
| 55-72 | 19.038 | 0.290 | 1,669 | 18.470 | 19.606 |

ProS\_La\_em2 <- pairs(ProS\_La\_em, adjust="Tukey")  
ProS\_La\_em3 <- as.data.frame(ProS\_La\_em2)  
  
ProS\_La\_em3$signif <- with(ProS\_La\_em3, ifelse(p.value < 0.05, 'TRUE', 'FALSE'))  
ProS\_La\_em3$p.value <- formatC(ProS\_La\_em3$p.value, format = "e")  
  
ProS\_La\_em2

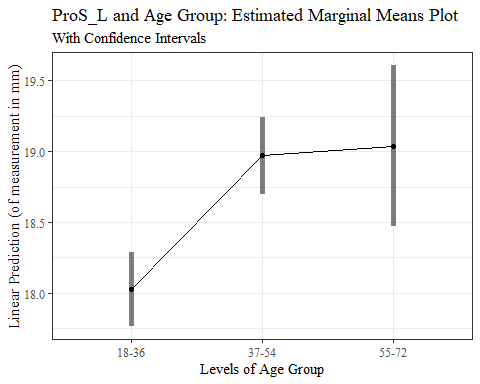
## contrast estimate SE df t.ratio p.value  
## (18-36) - (37-54) -0.9449 0.119 1669 -7.969 <.0001  
## (18-36) - (55-72) -1.0102 0.287 1669 -3.521 0.0013  
## (37-54) - (55-72) -0.0653 0.288 1669 -0.227 0.9720  
##   
## Results are averaged over the levels of: gender, race\_eth   
## P value adjustment: tukey method for comparing a family of 3 estimates

ProS\_La\_em3 <- ProS\_La\_em3 %>%   
 mutate(across(where(is.numeric), round, digits=3))  
  
flextable(ProS\_La\_em3) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("Tukey Pairwise Comparisons: ProS\_L and Age Group") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

**Table** **39**: Tukey Pairwise Comparisons: ProS\_L and Age Group

| **contrast** | **estimate** | **SE** | **df** | **t.ratio** | **p.value** | **signif** |
| --- | --- | --- | --- | --- | --- | --- |
| (18-36) - (37-54) | -0.945 | 0.119 | 1,669 | -7.969 | 1.6505e-12 | TRUE |
| (18-36) - (55-72) | -1.010 | 0.287 | 1,669 | -3.521 | 1.2805e-03 | TRUE |
| (37-54) - (55-72) | -0.065 | 0.288 | 1,669 | -0.227 | 9.7203e-01 | FALSE |

emmip\_ProS\_La <- emmip(ProS\_Lout, ~ age\_group, CIs = TRUE)  
  
emmip\_ProS\_La +   
 theme\_bw()+theme(text=element\_text(family= "Times New Roman"))+  
 labs(title="ProS\_L and Age Group: Estimated Marginal Means Plot",  
 subtitle="With Confidence Intervals",  
 y="Linear Prediction (of measurement in mm)",  
 x="Levels of Age Group")



SelP\_Lout <- aov(SelP\_L ~ gender+race\_eth+age\_group, data=chosen\_nona1)  
summary(SelP\_Lout)

## Df Sum Sq Mean Sq F value Pr(>F)   
## gender 1 5180 5180 357.647 < 2e-16 \*\*\*  
## race\_eth 4 1266 317 21.860 < 2e-16 \*\*\*  
## age\_group 2 150 75 5.195 0.00564 \*\*   
## Residuals 1669 24174 14   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

SelP\_Lout\_data <- as.data.frame(tidy(SelP\_Lout))

SelP\_Lout\_data <- rename(SelP\_Lout\_data, f.statistic = statistic)  
SelP\_Lout\_data$signif <- with(SelP\_Lout\_data, ifelse(p.value < 0.05, 'TRUE', 'FALSE'))  
SelP\_Lout\_data$p.value <- formatC(SelP\_Lout\_data$p.value, format = "e")  
  
  
SelP\_Lout\_data <- SelP\_Lout\_data %>%   
 mutate(across(where(is.numeric), round, digits=3))  
  
#Autofit Width Table TNR  
flextable(SelP\_Lout\_data) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("SelP\_L Additive Anova Model Findings") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

**Table** **40**: SelP\_L Additive Anova Model Findings

| **term** | **df** | **sumsq** | **meansq** | **f.statistic** | **p.value** | **signif** |
| --- | --- | --- | --- | --- | --- | --- |
| gender | 1 | 5,180.169 | 5,180.169 | 357.647 | 1.9931e-72 | TRUE |
| race\_eth | 4 | 1,266.462 | 316.616 | 21.860 | 1.3256e-17 | TRUE |
| age\_group | 2 | 150.476 | 75.238 | 5.195 | 5.6366e-03 | TRUE |
| Residuals | 1,669 | 24,173.820 | 14.484 |  | NA |  |

SelP\_Lg\_em <- emmeans(SelP\_Lout, ~ gender)  
SelP\_Lg\_em1 <- as.data.frame(SelP\_Lg\_em)  
  
SelP\_Lg\_em

## gender emmean SE df lower.CL upper.CL  
## Female/Other 42.8 0.249 1669 42.3 43.3  
## Male 46.5 0.251 1669 46.0 47.0  
##   
## Results are averaged over the levels of: race\_eth, age\_group   
## Confidence level used: 0.95

SelP\_Lg\_em1 <- SelP\_Lg\_em1 %>%   
 mutate(across(where(is.numeric), round, digits=3))  
  
flextable(SelP\_Lg\_em1) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("Estimated Marginal Means: SelP\_L and Gender") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

**Table 41**: Estimated Marginal Means: SelP\_L and Gender

| **gender** | **emmean** | **SE** | **df** | **lower.CL** | **upper.CL** |
| --- | --- | --- | --- | --- | --- |
| Female/Other | 42.789 | 0.249 | 1,669 | 42.30 | 43.277 |
| Male | 46.471 | 0.251 | 1,669 | 45.98 | 46.962 |

SelP\_Lg\_em2 <- pairs(SelP\_Lg\_em, adjust="Tukey")  
SelP\_Lg\_em3 <- as.data.frame(SelP\_Lg\_em2)  
  
SelP\_Lg\_em3$signif <- with(SelP\_Lg\_em3, ifelse(p.value < 0.05, 'TRUE', 'FALSE'))  
SelP\_Lg\_em3$p.value <- formatC(SelP\_Lg\_em3$p.value, format = "e")  
  
SelP\_Lg\_em2

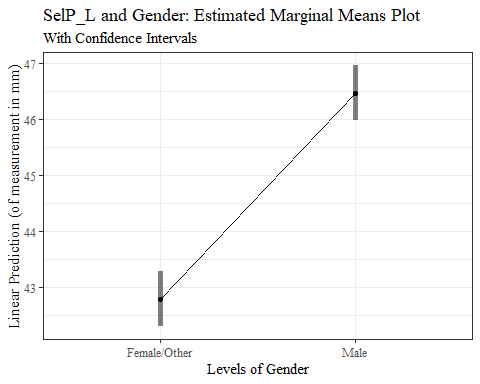
## contrast estimate SE df t.ratio p.value  
## (Female/Other) - Male -3.68 0.191 1669 -19.316 <.0001  
##   
## Results are averaged over the levels of: race\_eth, age\_group

SelP\_Lg\_em3 <- SelP\_Lg\_em3 %>%   
 mutate(across(where(is.numeric), round, digits=3))  
  
flextable(SelP\_Lg\_em3) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("Tukey Pairwise Comparisons: SelP\_L and Gender") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

**Table** **42**: Tukey Pairwise Comparisons: SelP\_L and Gender

| **contrast** | **estimate** | **SE** | **df** | **t.ratio** | **p.value** | **signif** |
| --- | --- | --- | --- | --- | --- | --- |
| (Female/Other) - Male | -3.682 | 0.191 | 1,669 | -19.316 | 3.4570e-75 | TRUE |

emmip\_SelP\_Lg <- emmip(SelP\_Lout, ~ gender, CIs = TRUE)  
  
emmip\_SelP\_Lg +   
 theme\_bw()+theme(text=element\_text(family= "Times New Roman"))+  
 labs(title="SelP\_L and Gender: Estimated Marginal Means Plot",  
 subtitle="With Confidence Intervals",  
 y="Linear Prediction (of measurement in mm)",  
 x="Levels of Gender")



SelP\_Lr\_em <- emmeans(SelP\_Lout, ~ race\_eth)  
SelP\_Lr\_em1 <- as.data.frame(SelP\_Lr\_em)  
  
SelP\_Lr\_em

## race\_eth emmean SE df lower.CL upper.CL  
## Asian 43.6 0.446 1669 42.8 44.5  
## Black 43.5 0.222 1669 43.0 43.9  
## LatinX 45.2 0.435 1669 44.4 46.1  
## Other 45.4 0.751 1669 43.9 46.8  
## white 45.4 0.178 1669 45.1 45.8  
##   
## Results are averaged over the levels of: gender, age\_group   
## Confidence level used: 0.95

SelP\_Lr\_em1 <- SelP\_Lr\_em1 %>%   
 mutate(across(where(is.numeric), round, digits=3))  
  
  
flextable(SelP\_Lr\_em1) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("Estimated Marginal Means: SelP\_L and Race/Ethnicity") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

**Table 43**: Estimated Marginal Means: SelP\_L and Race/Ethnicity

| **race\_eth** | **emmean** | **SE** | **df** | **lower.CL** | **upper.CL** |
| --- | --- | --- | --- | --- | --- |
| Asian | 43.650 | 0.446 | 1,669 | 42.774 | 44.526 |
| Black | 43.474 | 0.222 | 1,669 | 43.039 | 43.909 |
| LatinX | 45.234 | 0.435 | 1,669 | 44.380 | 46.088 |
| Other | 45.373 | 0.751 | 1,669 | 43.900 | 46.845 |
| white | 45.418 | 0.178 | 1,669 | 45.068 | 45.768 |

SelP\_Lr\_em2 <- pairs(SelP\_Lr\_em, adjust="Tukey")  
SelP\_Lr\_em3 <- as.data.frame(SelP\_Lr\_em2)  
  
SelP\_Lr\_em3$signif <- with(SelP\_Lr\_em3, ifelse(p.value < 0.05, 'TRUE', 'FALSE'))  
SelP\_Lr\_em3$p.value <- formatC(SelP\_Lr\_em3$p.value, format = "e")  
  
SelP\_Lr\_em2

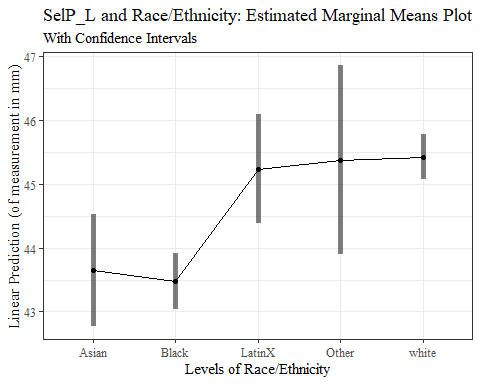
## contrast estimate SE df t.ratio p.value  
## Asian - Black 0.1758 0.462 1669 0.381 0.9956  
## Asian - LatinX -1.5843 0.593 1669 -2.672 0.0586  
## Asian - Other -1.7228 0.860 1669 -2.002 0.2653  
## Asian - white -1.7680 0.441 1669 -4.013 0.0006  
## Black - LatinX -1.7601 0.454 1669 -3.879 0.0010  
## Black - Other -1.8985 0.769 1669 -2.468 0.0986  
## Black - white -1.9437 0.216 1669 -8.998 <.0001  
## LatinX - Other -0.1385 0.856 1669 -0.162 0.9998  
## LatinX - white -0.1837 0.432 1669 -0.425 0.9932  
## Other - white -0.0452 0.758 1669 -0.060 1.0000  
##   
## Results are averaged over the levels of: gender, age\_group   
## P value adjustment: tukey method for comparing a family of 5 estimates

SelP\_Lr\_em3 <- SelP\_Lr\_em3 %>%   
 mutate(across(where(is.numeric), round, digits=3))  
  
  
flextable(SelP\_Lr\_em3) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("Tukey Pairwise Comparisons: SelP\_L and Race/Ethnicity") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

**Table** **44**: Tukey Pairwise Comparisons: SelP\_L and Race/Ethnicity

| **contrast** | **estimate** | **SE** | **df** | **t.ratio** | **p.value** | **signif** |
| --- | --- | --- | --- | --- | --- | --- |
| Asian - Black | 0.176 | 0.462 | 1,669 | 0.381 | 9.9555e-01 | FALSE |
| Asian - LatinX | -1.584 | 0.593 | 1,669 | -2.672 | 5.8637e-02 | FALSE |
| Asian - Other | -1.723 | 0.860 | 1,669 | -2.002 | 2.6528e-01 | FALSE |
| Asian - white | -1.768 | 0.441 | 1,669 | -4.013 | 5.9902e-04 | TRUE |
| Black - LatinX | -1.760 | 0.454 | 1,669 | -3.879 | 1.0301e-03 | TRUE |
| Black - Other | -1.899 | 0.769 | 1,669 | -2.468 | 9.8552e-02 | FALSE |
| Black - white | -1.944 | 0.216 | 1,669 | -8.998 | 1.6489e-12 | TRUE |
| LatinX - Other | -0.138 | 0.856 | 1,669 | -0.162 | 9.9985e-01 | FALSE |
| LatinX - white | -0.184 | 0.432 | 1,669 | -0.425 | 9.9320e-01 | FALSE |
| Other - white | -0.045 | 0.758 | 1,669 | -0.060 | 1.0000e+00 | FALSE |

emmip\_SelP\_Lr <- emmip(SelP\_Lout, ~ race\_eth, CIs = TRUE)  
  
emmip\_SelP\_Lr +   
 theme\_bw()+theme(text=element\_text(family= "Times New Roman"))+  
 labs(title="SelP\_L and Race/Ethnicity: Estimated Marginal Means Plot",  
 subtitle="With Confidence Intervals",  
 y="Linear Prediction (of measurement in mm)",  
 x="Levels of Race/Ethnicity")



SelP\_La\_em <- emmeans(SelP\_Lout, ~ age\_group)  
SelP\_La\_em1 <- as.data.frame(SelP\_La\_em)  
  
SelP\_La\_em

## age\_group emmean SE df lower.CL upper.CL  
## 18-36 44.2 0.216 1669 43.8 44.6  
## 37-54 44.8 0.224 1669 44.3 45.2  
## 55-72 44.9 0.468 1669 44.0 45.8  
##   
## Results are averaged over the levels of: gender, race\_eth   
## Confidence level used: 0.95

SelP\_La\_em1 <- SelP\_La\_em1 %>%   
 mutate(across(where(is.numeric), round, digits=3))  
  
flextable(SelP\_La\_em1) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("Estimated Marginal Means: SelP\_L and Age Group") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

**Table 45**: Estimated Marginal Means: SelP\_L and Age Group

| **age\_group** | **emmean** | **SE** | **df** | **lower.CL** | **upper.CL** |
| --- | --- | --- | --- | --- | --- |
| 18-36 | 44.192 | 0.216 | 1,669 | 43.769 | 44.615 |
| 37-54 | 44.781 | 0.224 | 1,669 | 44.341 | 45.220 |
| 55-72 | 44.917 | 0.468 | 1,669 | 43.999 | 45.835 |

SelP\_La\_em2 <- pairs(SelP\_La\_em, adjust="Tukey")  
SelP\_La\_em3 <- as.data.frame(SelP\_La\_em2)  
  
SelP\_La\_em3$signif <- with(SelP\_La\_em3, ifelse(p.value < 0.05, 'TRUE', 'FALSE'))  
SelP\_La\_em3$p.value <- formatC(SelP\_La\_em3$p.value, format = "e")  
  
SelP\_La\_em2

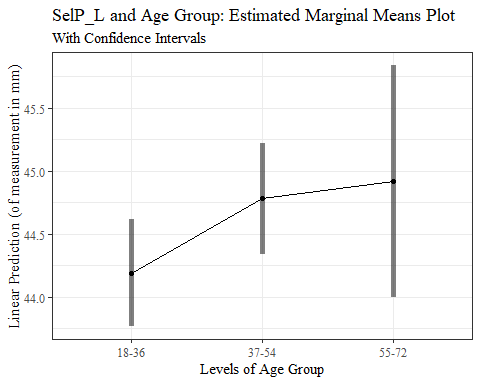
## contrast estimate SE df t.ratio p.value  
## (18-36) - (37-54) -0.589 0.192 1669 -3.073 0.0061  
## (18-36) - (55-72) -0.725 0.464 1669 -1.563 0.2619  
## (37-54) - (55-72) -0.136 0.465 1669 -0.292 0.9540  
##   
## Results are averaged over the levels of: gender, race\_eth   
## P value adjustment: tukey method for comparing a family of 3 estimates

SelP\_La\_em3 <- SelP\_La\_em3 %>%   
 mutate(across(where(is.numeric), round, digits=3))  
  
flextable(SelP\_La\_em3) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("Tukey Pairwise Comparisons: SelP\_L and Age Group") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

**Table** **46**: Tukey Pairwise Comparisons: SelP\_L and Age Group

| **contrast** | **estimate** | **SE** | **df** | **t.ratio** | **p.value** | **signif** |
| --- | --- | --- | --- | --- | --- | --- |
| (18-36) - (37-54) | -0.589 | 0.192 | 1,669 | -3.073 | 6.1003e-03 | TRUE |
| (18-36) - (55-72) | -0.725 | 0.464 | 1,669 | -1.563 | 2.6189e-01 | FALSE |
| (37-54) - (55-72) | -0.136 | 0.465 | 1,669 | -0.292 | 9.5398e-01 | FALSE |

emmip\_SelP\_La <- emmip(SelP\_Lout, ~ age\_group, CIs = TRUE)  
  
emmip\_SelP\_La +   
 theme\_bw()+theme(text=element\_text(family= "Times New Roman"))+  
 labs(title="SelP\_L and Age Group: Estimated Marginal Means Plot",  
 subtitle="With Confidence Intervals",  
 y="Linear Prediction (of measurement in mm)",  
 x="Levels of Age Group")



SelM\_Lout <- aov(SelM\_L ~ gender+race\_eth+age\_group, data=chosen\_nona1)  
summary(SelM\_Lout)

## Df Sum Sq Mean Sq F value Pr(>F)   
## gender 1 23613 23613 343.72 < 2e-16 \*\*\*  
## race\_eth 4 5134 1284 18.68 4.9e-15 \*\*\*  
## age\_group 2 743 372 5.41 0.00455 \*\*   
## Residuals 1669 114656 69   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

SelM\_Lout\_data <- as.data.frame(tidy(SelM\_Lout))

SelM\_Lout\_data <- rename(SelM\_Lout\_data, f.statistic = statistic)  
SelM\_Lout\_data$signif <- with(SelM\_Lout\_data, ifelse(p.value < 0.05, 'TRUE', 'FALSE'))  
SelM\_Lout\_data$p.value <- formatC(SelM\_Lout\_data$p.value, format = "e")  
  
SelM\_Lout\_data <- SelM\_Lout\_data %>%   
 mutate(across(where(is.numeric), round, digits=3))  
  
#Autofit Width Table TNR  
flextable(SelM\_Lout\_data) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("SelM\_L Additive Anova Model Findings") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

**Table** **47**: SelM\_L Additive Anova Model Findings

| **term** | **df** | **sumsq** | **meansq** | **f.statistic** | **p.value** | **signif** |
| --- | --- | --- | --- | --- | --- | --- |
| gender | 1 | 23,612.563 | 23,612.563 | 343.717 | 6.4011e-70 | TRUE |
| race\_eth | 4 | 5,134.038 | 1,283.510 | 18.683 | 4.8981e-15 | TRUE |
| age\_group | 2 | 743.249 | 371.625 | 5.410 | 4.5524e-03 | TRUE |
| Residuals | 1,669 | 114,656.314 | 68.698 |  | NA |  |

SelM\_Lg\_em <- emmeans(SelM\_Lout, ~ gender)  
SelM\_Lg\_em1 <- as.data.frame(SelM\_Lg\_em)  
  
SelM\_Lg\_em

## gender emmean SE df lower.CL upper.CL  
## Female/Other 112 0.542 1669 110 113  
## Male 119 0.546 1669 118 120  
##   
## Results are averaged over the levels of: race\_eth, age\_group   
## Confidence level used: 0.95

SelM\_Lg\_em1 <- SelM\_Lg\_em1 %>%   
 mutate(across(where(is.numeric), round, digits=3))  
  
flextable(SelM\_Lg\_em1) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("Estimated Marginal Means: SelM\_L and Gender") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

**Table 48**: Estimated Marginal Means: SelM\_L and Gender

| **gender** | **emmean** | **SE** | **df** | **lower.CL** | **upper.CL** |
| --- | --- | --- | --- | --- | --- |
| Female/Other | 111.509 | 0.542 | 1,669 | 110.445 | 112.572 |
| Male | 119.397 | 0.546 | 1,669 | 118.327 | 120.468 |

SelM\_Lg\_em2 <- pairs(SelM\_Lg\_em, adjust="Tukey")  
SelM\_Lg\_em3 <- as.data.frame(SelM\_Lg\_em2)  
  
SelM\_Lg\_em3$signif <- with(SelM\_Lg\_em3, ifelse(p.value < 0.05, 'TRUE', 'FALSE'))  
SelM\_Lg\_em3$p.value <- formatC(SelM\_Lg\_em3$p.value, format = "e")  
  
SelM\_Lg\_em2

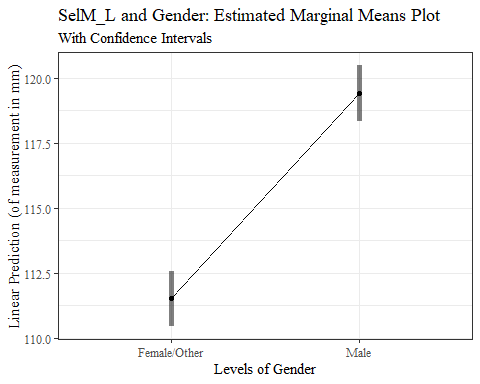
## contrast estimate SE df t.ratio p.value  
## (Female/Other) - Male -7.89 0.415 1669 -19.001 <.0001  
##   
## Results are averaged over the levels of: race\_eth, age\_group

SelM\_Lg\_em3 <- SelM\_Lg\_em3 %>%   
 mutate(across(where(is.numeric), round, digits=3))  
  
flextable(SelM\_Lg\_em3) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("Tukey Pairwise Comparisons: SelM\_L and Gender") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

**Table** **49**: Tukey Pairwise Comparisons: SelM\_L and Gender

| **contrast** | **estimate** | **SE** | **df** | **t.ratio** | **p.value** | **signif** |
| --- | --- | --- | --- | --- | --- | --- |
| (Female/Other) - Male | -7.889 | 0.415 | 1,669 | -19.001 | 4.8857e-73 | TRUE |

emmip\_SelM\_Lg <- emmip(SelM\_Lout, ~ gender, CIs = TRUE)  
  
emmip\_SelM\_Lg +   
 theme\_bw()+theme(text=element\_text(family= "Times New Roman"))+  
 labs(title="SelM\_L and Gender: Estimated Marginal Means Plot",  
 subtitle="With Confidence Intervals",  
 y="Linear Prediction (of measurement in mm)",  
 x="Levels of Gender")



SelM\_Lr\_em <- emmeans(SelM\_Lout, ~ race\_eth)  
SelM\_Lr\_em1 <- as.data.frame(SelM\_Lr\_em)  
  
SelM\_Lr\_em

## race\_eth emmean SE df lower.CL upper.CL  
## Asian 111 0.972 1669 110 113  
## Black 119 0.483 1669 118 120  
## LatinX 115 0.948 1669 113 117  
## Other 116 1.635 1669 112 119  
## white 116 0.388 1669 115 117  
##   
## Results are averaged over the levels of: gender, age\_group   
## Confidence level used: 0.95

SelM\_Lr\_em1 <- SelM\_Lr\_em1 %>%   
 mutate(across(where(is.numeric), round, digits=3))  
  
flextable(SelM\_Lr\_em1) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("Estimated Marginal Means: SelM\_L and Race/Ethnicity") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

**Table 50**: Estimated Marginal Means: SelM\_L and Race/Ethnicity

| **race\_eth** | **emmean** | **SE** | **df** | **lower.CL** | **upper.CL** |
| --- | --- | --- | --- | --- | --- |
| Asian | 111.439 | 0.972 | 1,669 | 109.532 | 113.347 |
| Black | 118.881 | 0.483 | 1,669 | 117.933 | 119.829 |
| LatinX | 115.144 | 0.948 | 1,669 | 113.284 | 117.004 |
| Other | 115.596 | 1.635 | 1,669 | 112.389 | 118.804 |
| white | 116.204 | 0.388 | 1,669 | 115.442 | 116.966 |

SelM\_Lr\_em2 <- pairs(SelM\_Lr\_em, adjust="Tukey")  
SelM\_Lr\_em3 <- as.data.frame(SelM\_Lr\_em2)  
  
SelM\_Lr\_em3$signif <- with(SelM\_Lr\_em3, ifelse(p.value < 0.05, 'TRUE', 'FALSE'))  
SelM\_Lr\_em3$p.value <- formatC(SelM\_Lr\_em3$p.value, format = "e")  
  
SelM\_Lr\_em2

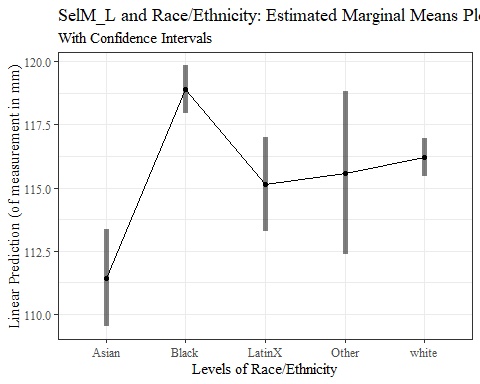
## contrast estimate SE df t.ratio p.value  
## Asian - Black -7.442 1.006 1669 -7.400 <.0001  
## Asian - LatinX -3.705 1.291 1669 -2.869 0.0339  
## Asian - Other -4.157 1.874 1669 -2.218 0.1733  
## Asian - white -4.764 0.960 1669 -4.965 <.0001  
## Black - LatinX 3.737 0.988 1669 3.782 0.0015  
## Black - Other 3.285 1.676 1669 1.960 0.2860  
## Black - white 2.678 0.470 1669 5.692 <.0001  
## LatinX - Other -0.452 1.864 1669 -0.243 0.9992  
## LatinX - white -1.059 0.941 1669 -1.126 0.7931  
## Other - white -0.607 1.650 1669 -0.368 0.9961  
##   
## Results are averaged over the levels of: gender, age\_group   
## P value adjustment: tukey method for comparing a family of 5 estimates

SelM\_Lr\_em3 <- SelM\_Lr\_em3 %>%   
 mutate(across(where(is.numeric), round, digits=3))  
  
flextable(SelM\_Lr\_em3) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("Tukey Pairwise Comparisons: SelM\_L and Race/Ethnicity") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

**Table** **51**: Tukey Pairwise Comparisons: SelM\_L and Race/Ethnicity

| **contrast** | **estimate** | **SE** | **df** | **t.ratio** | **p.value** | **signif** |
| --- | --- | --- | --- | --- | --- | --- |
| Asian - Black | -7.442 | 1.006 | 1,669 | -7.400 | 3.7907e-12 | TRUE |
| Asian - LatinX | -3.705 | 1.291 | 1,669 | -2.869 | 3.3894e-02 | TRUE |
| Asian - Other | -4.157 | 1.874 | 1,669 | -2.218 | 1.7330e-01 | FALSE |
| Asian - white | -4.764 | 0.960 | 1,669 | -4.965 | 7.4964e-06 | TRUE |
| Black - LatinX | 3.737 | 0.988 | 1,669 | 3.782 | 1.5110e-03 | TRUE |
| Black - Other | 3.285 | 1.676 | 1,669 | 1.960 | 2.8601e-01 | FALSE |
| Black - white | 2.678 | 0.470 | 1,669 | 5.692 | 1.4767e-07 | TRUE |
| LatinX - Other | -0.452 | 1.864 | 1,669 | -0.243 | 9.9923e-01 | FALSE |
| LatinX - white | -1.059 | 0.941 | 1,669 | -1.126 | 7.9306e-01 | FALSE |
| Other - white | -0.607 | 1.650 | 1,669 | -0.368 | 9.9609e-01 | FALSE |

emmip\_SelM\_Lr <- emmip(SelM\_Lout, ~ race\_eth, CIs = TRUE)  
  
emmip\_SelM\_Lr +   
 theme\_bw()+theme(text=element\_text(family= "Times New Roman"))+  
 labs(title="SelM\_L and Race/Ethnicity: Estimated Marginal Means Plot",  
 subtitle="With Confidence Intervals",  
 y="Linear Prediction (of measurement in mm)",  
 x="Levels of Race/Ethnicity")



SelM\_La\_em <- emmeans(SelM\_Lout, ~ age\_group)  
SelM\_La\_em1 <- as.data.frame(SelM\_La\_em)  
  
SelM\_La\_em

## age\_group emmean SE df lower.CL upper.CL  
## 18-36 115 0.470 1669 114 116  
## 37-54 117 0.488 1669 116 117  
## 55-72 115 1.020 1669 113 117  
##   
## Results are averaged over the levels of: gender, race\_eth   
## Confidence level used: 0.95

SelM\_La\_em1 <- SelM\_La\_em1 %>%   
 mutate(across(where(is.numeric), round, digits=3))  
  
flextable(SelM\_La\_em1) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("Estimated Marginal Means: SelM\_L and Age Group") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

**Table 52**: Estimated Marginal Means: SelM\_L and Age Group

| **age\_group** | **emmean** | **SE** | **df** | **lower.CL** | **upper.CL** |
| --- | --- | --- | --- | --- | --- |
| 18-36 | 115.283 | 0.470 | 1,669 | 114.361 | 116.205 |
| 37-54 | 116.534 | 0.488 | 1,669 | 115.577 | 117.491 |
| 55-72 | 114.542 | 1.020 | 1,669 | 112.542 | 116.541 |

SelM\_La\_em2 <- pairs(SelM\_La\_em, adjust="Tukey")  
SelM\_La\_em3 <- as.data.frame(SelM\_La\_em2)  
  
SelM\_La\_em3$signif <- with(SelM\_La\_em3, ifelse(p.value < 0.05, 'TRUE', 'FALSE'))  
SelM\_La\_em3$p.value <- formatC(SelM\_La\_em3$p.value, format = "e")  
  
SelM\_La\_em2

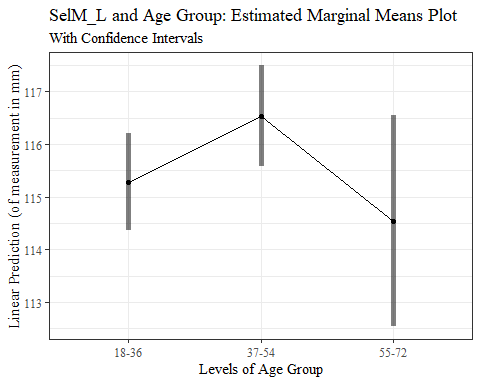
## contrast estimate SE df t.ratio p.value  
## (18-36) - (37-54) -1.251 0.417 1669 -2.997 0.0078  
## (18-36) - (55-72) 0.742 1.010 1669 0.735 0.7430  
## (37-54) - (55-72) 1.993 1.013 1669 1.966 0.1209  
##   
## Results are averaged over the levels of: gender, race\_eth   
## P value adjustment: tukey method for comparing a family of 3 estimates

SelM\_La\_em3 <- SelM\_La\_em3 %>%   
 mutate(across(where(is.numeric), round, digits=3))  
  
flextable(SelM\_La\_em3) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("Tukey Pairwise Comparisons: SelM\_L and Age Group") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

**Table** **53**: Tukey Pairwise Comparisons: SelM\_L and Age Group

| **contrast** | **estimate** | **SE** | **df** | **t.ratio** | **p.value** | **signif** |
| --- | --- | --- | --- | --- | --- | --- |
| (18-36) - (37-54) | -1.251 | 0.417 | 1,669 | -2.997 | 7.7968e-03 | TRUE |
| (18-36) - (55-72) | 0.742 | 1.010 | 1,669 | 0.735 | 7.4299e-01 | FALSE |
| (37-54) - (55-72) | 1.993 | 1.013 | 1,669 | 1.966 | 1.2090e-01 | FALSE |

emmip\_SelM\_La <- emmip(SelM\_Lout, ~ age\_group, CIs = TRUE)  
  
emmip\_SelM\_La +   
 theme\_bw()+theme(text=element\_text(family= "Times New Roman"))+  
 labs(title="SelM\_L and Age Group: Estimated Marginal Means Plot",  
 subtitle="With Confidence Intervals",  
 y="Linear Prediction (of measurement in mm)",  
 x="Levels of Age Group")



SnasM\_Cout <- aov(SnasM\_C ~ gender+race\_eth+age\_group, data=chosen\_nona1)  
summary(SnasM\_Cout)

## Df Sum Sq Mean Sq F value Pr(>F)   
## gender 1 10513 10513 117.559 <2e-16 \*\*\*  
## race\_eth 4 21905 5476 61.236 <2e-16 \*\*\*  
## age\_group 2 473 237 2.645 0.0713 .   
## Residuals 1669 149254 89   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

SnasM\_Cout\_data <- as.data.frame(tidy(SnasM\_Cout))

SnasM\_Cout\_data <- rename(SnasM\_Cout\_data, f.statistic = statistic)  
SnasM\_Cout\_data$signif <- with(SnasM\_Cout\_data, ifelse(p.value < 0.05, 'TRUE', 'FALSE'))  
SnasM\_Cout\_data$p.value <- formatC(SnasM\_Cout\_data$p.value, format = "e")  
  
SnasM\_Cout\_data <- SnasM\_Cout\_data %>%   
 mutate(across(where(is.numeric), round, digits=3))  
  
#Autofit Width Table TNR  
flextable(SnasM\_Cout\_data) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("SnasM\_C Additive Anova Model Findings") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

**Table** **54**: SnasM\_C Additive Anova Model Findings

| **term** | **df** | **sumsq** | **meansq** | **f.statistic** | **p.value** | **signif** |
| --- | --- | --- | --- | --- | --- | --- |
| gender | 1 | 10,512.961 | 10,512.961 | 117.559 | 1.6190e-26 | TRUE |
| race\_eth | 4 | 21,904.787 | 5,476.197 | 61.236 | 2.5247e-48 | TRUE |
| age\_group | 2 | 473.018 | 236.509 | 2.645 | 7.1324e-02 | FALSE |
| Residuals | 1,669 | 149,253.969 | 89.427 |  | NA |  |

SnasM\_Cg\_em <- emmeans(SnasM\_Cout, ~ gender)  
SnasM\_Cg\_em1 <- as.data.frame(SnasM\_Cg\_em)  
  
SnasM\_Cg\_em

## gender emmean SE df lower.CL upper.CL  
## Female/Other 71.5 0.619 1669 70.3 72.7  
## Male 76.6 0.623 1669 75.4 77.8  
##   
## Results are averaged over the levels of: race\_eth, age\_group   
## Confidence level used: 0.95

SnasM\_Cg\_em1 <- SnasM\_Cg\_em1 %>%   
 mutate(across(where(is.numeric), round, digits=3))  
  
flextable(SnasM\_Cg\_em1) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("Estimated Marginal Means: SnasM\_C and Gender") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

**Table 55**: Estimated Marginal Means: SnasM\_C and Gender

| **gender** | **emmean** | **SE** | **df** | **lower.CL** | **upper.CL** |
| --- | --- | --- | --- | --- | --- |
| Female/Other | 71.466 | 0.619 | 1,669 | 70.253 | 72.679 |
| Male | 76.590 | 0.623 | 1,669 | 75.369 | 77.811 |

SnasM\_Cg\_em2 <- pairs(SnasM\_Cg\_em, adjust="Tukey")  
SnasM\_Cg\_em3 <- as.data.frame(SnasM\_Cg\_em2)  
  
SnasM\_Cg\_em3$signif <- with(SnasM\_Cg\_em3, ifelse(p.value < 0.05, 'TRUE', 'FALSE'))  
SnasM\_Cg\_em3$p.value <- formatC(SnasM\_Cg\_em3$p.value, format = "e")  
  
SnasM\_Cg\_em2

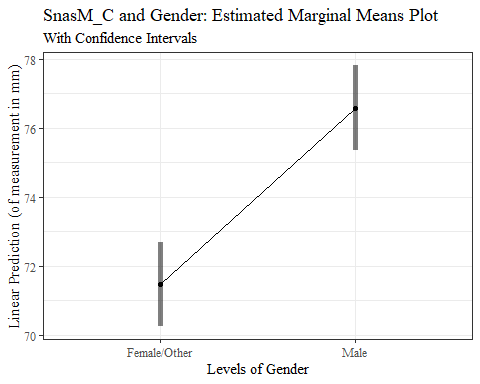
## contrast estimate SE df t.ratio p.value  
## (Female/Other) - Male -5.12 0.474 1669 -10.817 <.0001  
##   
## Results are averaged over the levels of: race\_eth, age\_group

SnasM\_Cg\_em3 <- SnasM\_Cg\_em3 %>%   
 mutate(across(where(is.numeric), round, digits=3))  
  
flextable(SnasM\_Cg\_em3) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("Tukey Pairwise Comparisons: SnasM\_C and Gender") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

**Table** **56**: Tukey Pairwise Comparisons: SnasM\_C and Gender

| **contrast** | **estimate** | **SE** | **df** | **t.ratio** | **p.value** | **signif** |
| --- | --- | --- | --- | --- | --- | --- |
| (Female/Other) - Male | -5.124 | 0.474 | 1,669 | -10.817 | 2.0944e-26 | TRUE |

emmip\_SnasM\_Cg <- emmip(SnasM\_Cout, ~ gender, CIs = TRUE)  
  
emmip\_SnasM\_Cg +   
 theme\_bw()+theme(text=element\_text(family= "Times New Roman"))+  
 labs(title="SnasM\_C and Gender: Estimated Marginal Means Plot",  
 subtitle="With Confidence Intervals",  
 y="Linear Prediction (of measurement in mm)",  
 x="Levels of Gender")



SnasM\_Cr\_em <- emmeans(SnasM\_Cout, ~ race\_eth)  
SnasM\_Cr\_em1 <- as.data.frame(SnasM\_Cr\_em)  
  
SnasM\_Cr\_em

## race\_eth emmean SE df lower.CL upper.CL  
## Asian 70.6 1.109 1669 68.5 72.8  
## Black 80.7 0.551 1669 79.6 81.8  
## LatinX 72.7 1.082 1669 70.6 74.8  
## Other 73.5 1.866 1669 69.8 77.2  
## white 72.6 0.443 1669 71.8 73.5  
##   
## Results are averaged over the levels of: gender, age\_group   
## Confidence level used: 0.95

SnasM\_Cr\_em1 <- SnasM\_Cr\_em1 %>%   
 mutate(across(where(is.numeric), round, digits=3))  
  
flextable(SnasM\_Cr\_em1) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("Estimated Marginal Means: SnasM\_C and Race/Ethnicity") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

**Table 57**: Estimated Marginal Means: SnasM\_C and Race/Ethnicity

| **race\_eth** | **emmean** | **SE** | **df** | **lower.CL** | **upper.CL** |
| --- | --- | --- | --- | --- | --- |
| Asian | 70.643 | 1.109 | 1,669 | 68.467 | 72.819 |
| Black | 80.678 | 0.551 | 1,669 | 79.596 | 81.759 |
| LatinX | 72.683 | 1.082 | 1,669 | 70.560 | 74.805 |
| Other | 73.505 | 1.866 | 1,669 | 69.846 | 77.164 |
| white | 72.631 | 0.443 | 1,669 | 71.762 | 73.501 |

SnasM\_Cr\_em2 <- pairs(SnasM\_Cr\_em, adjust="Tukey")  
SnasM\_Cr\_em3 <- as.data.frame(SnasM\_Cr\_em2)  
  
SnasM\_Cr\_em3$signif <- with(SnasM\_Cr\_em3, ifelse(p.value < 0.05, 'TRUE', 'FALSE'))  
SnasM\_Cr\_em3$p.value <- formatC(SnasM\_Cr\_em3$p.value, format = "e")  
  
SnasM\_Cr\_em2

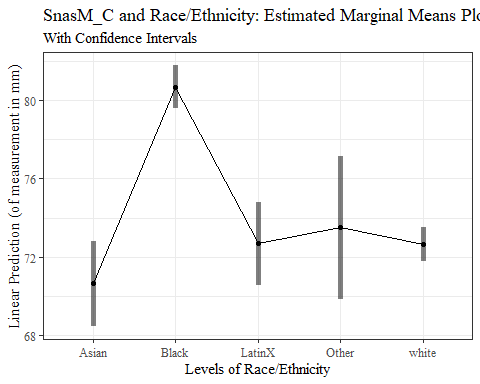
## contrast estimate SE df t.ratio p.value  
## Asian - Black -10.0345 1.147 1669 -8.745 <.0001  
## Asian - LatinX -2.0394 1.473 1669 -1.384 0.6380  
## Asian - Other -2.8616 2.138 1669 -1.338 0.6672  
## Asian - white -1.9881 1.095 1669 -1.816 0.3646  
## Black - LatinX 7.9950 1.127 1669 7.092 <.0001  
## Black - Other 7.1729 1.912 1669 3.752 0.0017  
## Black - white 8.0464 0.537 1669 14.991 <.0001  
## LatinX - Other -0.8221 2.126 1669 -0.387 0.9953  
## LatinX - white 0.0513 1.074 1669 0.048 1.0000  
## Other - white 0.8735 1.882 1669 0.464 0.9905  
##   
## Results are averaged over the levels of: gender, age\_group   
## P value adjustment: tukey method for comparing a family of 5 estimates

SnasM\_Cr\_em3 <- SnasM\_Cr\_em3 %>%   
 mutate(across(where(is.numeric), round, digits=3))  
  
flextable(SnasM\_Cr\_em3) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("Tukey Pairwise Comparisons: SnasM\_C and Race/Ethnicity") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

**Table** **58**: Tukey Pairwise Comparisons: SnasM\_C and Race/Ethnicity

| **contrast** | **estimate** | **SE** | **df** | **t.ratio** | **p.value** | **signif** |
| --- | --- | --- | --- | --- | --- | --- |
| Asian - Black | -10.034 | 1.147 | 1,669 | -8.745 | 1.6447e-12 | TRUE |
| Asian - LatinX | -2.039 | 1.473 | 1,669 | -1.384 | 6.3797e-01 | FALSE |
| Asian - Other | -2.862 | 2.138 | 1,669 | -1.338 | 6.6716e-01 | FALSE |
| Asian - white | -1.988 | 1.095 | 1,669 | -1.816 | 3.6456e-01 | FALSE |
| Black - LatinX | 7.995 | 1.127 | 1,669 | 7.092 | 2.1127e-11 | TRUE |
| Black - Other | 7.173 | 1.912 | 1,669 | 3.752 | 1.6979e-03 | TRUE |
| Black - white | 8.046 | 0.537 | 1,669 | 14.991 | 1.6044e-12 | TRUE |
| LatinX - Other | -0.822 | 2.126 | 1,669 | -0.387 | 9.9527e-01 | FALSE |
| LatinX - white | 0.051 | 1.074 | 1,669 | 0.048 | 1.0000e+00 | FALSE |
| Other - white | 0.873 | 1.882 | 1,669 | 0.464 | 9.9048e-01 | FALSE |

emmip\_SnasM\_Cr <- emmip(SnasM\_Cout, ~ race\_eth, CIs = TRUE)  
  
emmip\_SnasM\_Cr +   
 theme\_bw()+theme(text=element\_text(family= "Times New Roman"))+  
 labs(title="SnasM\_C and Race/Ethnicity: Estimated Marginal Means Plot",  
 subtitle="With Confidence Intervals",  
 y="Linear Prediction (of measurement in mm)",  
 x="Levels of Race/Ethnicity")



TrSman\_Cout <- aov(TrSman\_C ~ gender+race\_eth+age\_group, data=chosen\_nona1)  
summary(TrSman\_Cout)

## Df Sum Sq Mean Sq F value Pr(>F)   
## gender 1 74244 74244 610.52 <2e-16 \*\*\*  
## race\_eth 4 10539 2635 21.66 <2e-16 \*\*\*  
## age\_group 2 18223 9111 74.92 <2e-16 \*\*\*  
## Residuals 1669 202964 122   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

TrSman\_Cout\_data <- as.data.frame(tidy(TrSman\_Cout))

TrSman\_Cout\_data <- rename(TrSman\_Cout\_data, f.statistic = statistic)  
TrSman\_Cout\_data$signif <- with(TrSman\_Cout\_data, ifelse(p.value < 0.05, 'TRUE', 'FALSE'))  
TrSman\_Cout\_data$p.value <- formatC(TrSman\_Cout\_data$p.value, format = "e")  
  
TrSman\_Cout\_data <- TrSman\_Cout\_data %>%   
 mutate(across(where(is.numeric), round, digits=3))  
  
#Autofit Width Table TNR  
flextable(TrSman\_Cout\_data) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("TrSman\_C Additive Anova Model Findings") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

**Table** **59**: TrSman\_C Additive Anova Model Findings

| **term** | **df** | **sumsq** | **meansq** | **f.statistic** | **p.value** | **signif** |
| --- | --- | --- | --- | --- | --- | --- |
| gender | 1 | 74,244.19 | 74,244.193 | 610.519 | 3.9414e-115 | TRUE |
| race\_eth | 4 | 10,538.76 | 2,634.690 | 21.665 | 1.9020e-17 | TRUE |
| age\_group | 2 | 18,222.63 | 9,111.315 | 74.923 | 6.9171e-32 | TRUE |
| Residuals | 1,669 | 202,964.27 | 121.608 |  | NA |  |

TrSman\_Cg\_em <- emmeans(TrSman\_Cout, ~ gender)  
TrSman\_Cg\_em1 <- as.data.frame(TrSman\_Cg\_em)  
  
TrSman\_Cg\_em

## gender emmean SE df lower.CL upper.CL  
## Female/Other 147 0.721 1669 145 148  
## Male 161 0.726 1669 159 162  
##   
## Results are averaged over the levels of: race\_eth, age\_group   
## Confidence level used: 0.95

TrSman\_Cg\_em1 <- TrSman\_Cg\_em1 %>%   
 mutate(across(where(is.numeric), round, digits=3))  
  
flextable(TrSman\_Cg\_em1) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("Estimated Marginal Means: TrSman\_C and Gender") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

**Table 60**: Estimated Marginal Means: TrSman\_C and Gender

| **gender** | **emmean** | **SE** | **df** | **lower.CL** | **upper.CL** |
| --- | --- | --- | --- | --- | --- |
| Female/Other | 146.822 | 0.721 | 1,669 | 145.407 | 148.236 |
| Male | 160.778 | 0.726 | 1,669 | 159.354 | 162.202 |

TrSman\_Cg\_em2 <- pairs(TrSman\_Cg\_em, adjust="Tukey")  
TrSman\_Cg\_em3 <- as.data.frame(TrSman\_Cg\_em2)  
  
TrSman\_Cg\_em3$signif <- with(TrSman\_Cg\_em3, ifelse(p.value < 0.05, 'TRUE', 'FALSE'))  
TrSman\_Cg\_em3$p.value <- formatC(TrSman\_Cg\_em3$p.value, format = "e")  
  
TrSman\_Cg\_em2

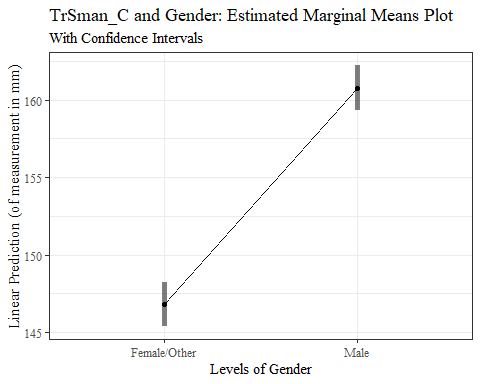
## contrast estimate SE df t.ratio p.value  
## (Female/Other) - Male -14 0.552 1669 -25.266 <.0001  
##   
## Results are averaged over the levels of: race\_eth, age\_group

TrSman\_Cg\_em3 <- TrSman\_Cg\_em3 %>%   
 mutate(across(where(is.numeric), round, digits=3))  
  
flextable(TrSman\_Cg\_em3) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("Tukey Pairwise Comparisons: TrSman\_C and Gender") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

**Table** **61**: Tukey Pairwise Comparisons: TrSman\_C and Gender

| **contrast** | **estimate** | **SE** | **df** | **t.ratio** | **p.value** | **signif** |
| --- | --- | --- | --- | --- | --- | --- |
| (Female/Other) - Male | -13.956 | 0.552 | 1,669 | -25.266 | 1.5461e-119 | TRUE |

emmip\_TrSman\_Cg <- emmip(TrSman\_Cout, ~ gender, CIs = TRUE)  
  
emmip\_TrSman\_Cg +   
 theme\_bw()+theme(text=element\_text(family= "Times New Roman"))+  
 labs(title="TrSman\_C and Gender: Estimated Marginal Means Plot",  
 subtitle="With Confidence Intervals",  
 y="Linear Prediction (of measurement in mm)",  
 x="Levels of Gender")



TrSman\_Cr\_em <- emmeans(TrSman\_Cout, ~ race\_eth)  
TrSman\_Cr\_em1 <- as.data.frame(TrSman\_Cr\_em)  
  
TrSman\_Cr\_em

## race\_eth emmean SE df lower.CL upper.CL  
## Asian 152 1.294 1669 149 154  
## Black 159 0.643 1669 157 160  
## LatinX 153 1.262 1669 151 156  
## Other 152 2.176 1669 147 156  
## white 154 0.517 1669 153 155  
##   
## Results are averaged over the levels of: gender, age\_group   
## Confidence level used: 0.95

TrSman\_Cr\_em1 <- TrSman\_Cr\_em1 %>%   
 mutate(across(where(is.numeric), round, digits=3))  
  
flextable(TrSman\_Cr\_em1) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("Estimated Marginal Means: TrSman\_C and Race/Ethnicity") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

**Table 62**: Estimated Marginal Means: TrSman\_C and Race/Ethnicity

| **race\_eth** | **emmean** | **SE** | **df** | **lower.CL** | **upper.CL** |
| --- | --- | --- | --- | --- | --- |
| Asian | 151.652 | 1.294 | 1,669 | 149.115 | 154.190 |
| Black | 158.543 | 0.643 | 1,669 | 157.282 | 159.804 |
| LatinX | 153.329 | 1.262 | 1,669 | 150.854 | 155.804 |
| Other | 151.539 | 2.176 | 1,669 | 147.272 | 155.806 |
| white | 153.936 | 0.517 | 1,669 | 152.923 | 154.950 |

TrSman\_Cr\_em2 <- pairs(TrSman\_Cr\_em, adjust="Tukey")  
TrSman\_Cr\_em3 <- as.data.frame(TrSman\_Cr\_em2)  
  
TrSman\_Cr\_em3$signif <- with(TrSman\_Cr\_em3, ifelse(p.value < 0.05, 'TRUE', 'FALSE'))  
TrSman\_Cr\_em3$p.value <- formatC(TrSman\_Cr\_em3$p.value, format = "e")  
  
TrSman\_Cr\_em2

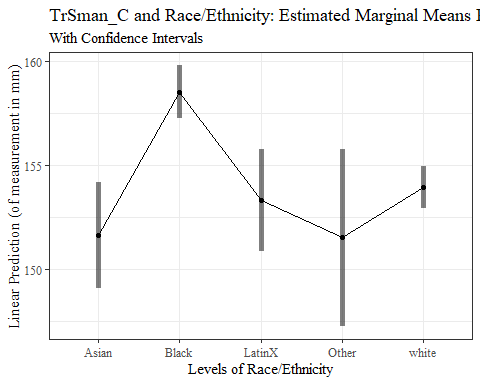
## contrast estimate SE df t.ratio p.value  
## Asian - Black -6.891 1.338 1669 -5.150 <.0001  
## Asian - LatinX -1.677 1.718 1669 -0.976 0.8662  
## Asian - Other 0.113 2.493 1669 0.046 1.0000  
## Asian - white -2.284 1.277 1669 -1.789 0.3802  
## Black - LatinX 5.214 1.315 1669 3.966 0.0007  
## Black - Other 7.004 2.229 1669 3.142 0.0147  
## Black - white 4.607 0.626 1669 7.360 <.0001  
## LatinX - Other 1.790 2.480 1669 0.722 0.9515  
## LatinX - white -0.608 1.252 1669 -0.485 0.9887  
## Other - white -2.398 2.195 1669 -1.092 0.8106  
##   
## Results are averaged over the levels of: gender, age\_group   
## P value adjustment: tukey method for comparing a family of 5 estimates

TrSman\_Cr\_em3 <- TrSman\_Cr\_em3 %>%   
 mutate(across(where(is.numeric), round, digits=3))  
  
flextable(TrSman\_Cr\_em3) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("Tukey Pairwise Comparisons: TrSman\_C and Race/Ethnicity") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

**Table** **63**: Tukey Pairwise Comparisons: TrSman\_C and Race/Ethnicity

| **contrast** | **estimate** | **SE** | **df** | **t.ratio** | **p.value** | **signif** |
| --- | --- | --- | --- | --- | --- | --- |
| Asian - Black | -6.891 | 1.338 | 1,669 | -5.150 | 2.8966e-06 | TRUE |
| Asian - LatinX | -1.677 | 1.718 | 1,669 | -0.976 | 8.6621e-01 | FALSE |
| Asian - Other | 0.113 | 2.493 | 1,669 | 0.046 | 1.0000e+00 | FALSE |
| Asian - white | -2.284 | 1.277 | 1,669 | -1.789 | 3.8016e-01 | FALSE |
| Black - LatinX | 5.214 | 1.315 | 1,669 | 3.966 | 7.2486e-04 | TRUE |
| Black - Other | 7.004 | 2.229 | 1,669 | 3.142 | 1.4717e-02 | TRUE |
| Black - white | 4.607 | 0.626 | 1,669 | 7.360 | 4.5137e-12 | TRUE |
| LatinX - Other | 1.790 | 2.480 | 1,669 | 0.722 | 9.5149e-01 | FALSE |
| LatinX - white | -0.608 | 1.252 | 1,669 | -0.485 | 9.8872e-01 | FALSE |
| Other - white | -2.398 | 2.195 | 1,669 | -1.092 | 8.1055e-01 | FALSE |

emmip\_TrSman\_Cr <- emmip(TrSman\_Cout, ~ race\_eth, CIs = TRUE)  
  
emmip\_TrSman\_Cr +   
 theme\_bw()+theme(text=element\_text(family= "Times New Roman"))+  
 labs(title="TrSman\_C and Race/Ethnicity: Estimated Marginal Means Plot",  
 subtitle="With Confidence Intervals",  
 y="Linear Prediction (of measurement in mm)",  
 x="Levels of Race/Ethnicity")



TrSman\_Ca\_em <- emmeans(TrSman\_Cout, ~ age\_group)  
TrSman\_Ca\_em1 <- as.data.frame(TrSman\_Ca\_em)  
  
TrSman\_Ca\_em

## age\_group emmean SE df lower.CL upper.CL  
## 18-36 149 0.625 1669 148 150  
## 37-54 155 0.649 1669 154 157  
## 55-72 157 1.356 1669 154 160  
##   
## Results are averaged over the levels of: gender, race\_eth   
## Confidence level used: 0.95

TrSman\_Ca\_em1 <- TrSman\_Ca\_em1 %>%   
 mutate(across(where(is.numeric), round, digits=3))  
  
flextable(TrSman\_Ca\_em1) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("Estimated Marginal Means: TrSman\_C and Age Group") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

**Table 64**: Estimated Marginal Means: TrSman\_C and Age Group

| **age\_group** | **emmean** | **SE** | **df** | **lower.CL** | **upper.CL** |
| --- | --- | --- | --- | --- | --- |
| 18-36 | 148.983 | 0.625 | 1,669 | 147.757 | 150.21 |
| 37-54 | 155.466 | 0.649 | 1,669 | 154.193 | 156.74 |
| 55-72 | 156.950 | 1.356 | 1,669 | 154.289 | 159.61 |

TrSman\_Ca\_em2 <- pairs(TrSman\_Ca\_em, adjust="Tukey")  
TrSman\_Ca\_em3 <- as.data.frame(TrSman\_Ca\_em2)  
  
TrSman\_Ca\_em3$signif <- with(TrSman\_Ca\_em3, ifelse(p.value < 0.05, 'TRUE', 'FALSE'))  
TrSman\_Ca\_em3$p.value <- formatC(TrSman\_Ca\_em3$p.value, format = "e")  
  
TrSman\_Ca\_em2

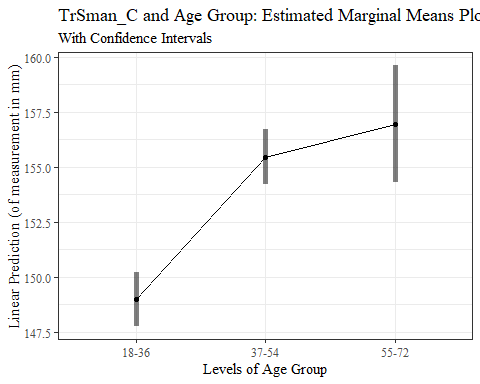
## contrast estimate SE df t.ratio p.value  
## (18-36) - (37-54) -6.48 0.555 1669 -11.673 <.0001  
## (18-36) - (55-72) -7.97 1.344 1669 -5.929 <.0001  
## (37-54) - (55-72) -1.48 1.348 1669 -1.100 0.5141  
##   
## Results are averaged over the levels of: gender, race\_eth   
## P value adjustment: tukey method for comparing a family of 3 estimates

TrSman\_Ca\_em3 <- TrSman\_Ca\_em3 %>%   
 mutate(across(where(is.numeric), round, digits=3))  
  
flextable(TrSman\_Ca\_em3) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("Tukey Pairwise Comparisons: TrSman\_C and Age Group") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

**Table** **65**: Tukey Pairwise Comparisons: TrSman\_C and Age Group

| **contrast** | **estimate** | **SE** | **df** | **t.ratio** | **p.value** | **signif** |
| --- | --- | --- | --- | --- | --- | --- |
| (18-36) - (37-54) | -6.483 | 0.555 | 1,669 | -11.673 | 1.6046e-12 | TRUE |
| (18-36) - (55-72) | -7.966 | 1.344 | 1,669 | -5.929 | 1.1100e-08 | TRUE |
| (37-54) - (55-72) | -1.483 | 1.348 | 1,669 | -1.100 | 5.1411e-01 | FALSE |

emmip\_TrSman\_Ca <- emmip(TrSman\_Cout, ~ age\_group, CIs = TRUE)  
  
emmip\_TrSman\_Ca +   
 theme\_bw()+theme(text=element\_text(family= "Times New Roman"))+  
 labs(title="TrSman\_C and Age Group: Estimated Marginal Means Plot",  
 subtitle="With Confidence Intervals",  
 y="Linear Prediction (of measurement in mm)",  
 x="Levels of Age Group")



TrTr\_Cout <- aov(TrTr\_C ~ gender+race\_eth+age\_group, data=chosen\_nona1)  
summary(TrTr\_Cout)

## Df Sum Sq Mean Sq F value Pr(>F)   
## gender 1 76795 76795 561.345 < 2e-16 \*\*\*  
## race\_eth 4 18219 4555 33.294 < 2e-16 \*\*\*  
## age\_group 2 2640 1320 9.647 6.83e-05 \*\*\*  
## Residuals 1669 228328 137   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

TrTr\_Cout\_data <- as.data.frame(tidy(TrTr\_Cout))

TrTr\_Cout\_data <- rename(TrTr\_Cout\_data, f.statistic = statistic)  
TrTr\_Cout\_data$signif <- with(TrTr\_Cout\_data, ifelse(p.value < 0.05, 'TRUE', 'FALSE'))  
TrTr\_Cout\_data$p.value <- formatC(TrTr\_Cout\_data$p.value, format = "e")  
  
  
  
TrTr\_Cout\_data <- TrTr\_Cout\_data %>%   
 mutate(across(where(is.numeric), round, digits=3))  
  
#Autofit Width Table TNR  
flextable(TrTr\_Cout\_data) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("TrTr\_C Additive Anova Model Findings") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

**Table** **66**: TrTr\_C Additive Anova Model Findings

| **term** | **df** | **sumsq** | **meansq** | **f.statistic** | **p.value** | **signif** |
| --- | --- | --- | --- | --- | --- | --- |
| gender | 1 | 76,794.99 | 76,794.985 | 561.345 | 3.2573e-107 | TRUE |
| race\_eth | 4 | 18,219.45 | 4,554.862 | 33.294 | 9.4130e-27 | TRUE |
| age\_group | 2 | 2,639.58 | 1,319.790 | 9.647 | 6.8282e-05 | TRUE |
| Residuals | 1,669 | 228,328.26 | 136.805 |  | NA |  |

TrTr\_Cg\_em <- emmeans(TrTr\_Cout, ~ gender)  
TrTr\_Cg\_em1 <- as.data.frame(TrTr\_Cg\_em)  
  
TrTr\_Cg\_em

## gender emmean SE df lower.CL upper.CL  
## Female/Other 276 0.765 1669 275 278  
## Male 290 0.770 1669 288 291  
##   
## Results are averaged over the levels of: race\_eth, age\_group   
## Confidence level used: 0.95

TrTr\_Cg\_em1 <- TrTr\_Cg\_em1 %>%   
 mutate(across(where(is.numeric), round, digits=3))  
  
flextable(TrTr\_Cg\_em1) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("Estimated Marginal Means: TrTr\_C and Gender") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

**Table 67**: Estimated Marginal Means: TrTr\_C and Gender

| **gender** | **emmean** | **SE** | **df** | **lower.CL** | **upper.CL** |
| --- | --- | --- | --- | --- | --- |
| Female/Other | 276.078 | 0.765 | 1,669 | 274.577 | 277.578 |
| Male | 289.823 | 0.770 | 1,669 | 288.312 | 291.333 |

TrTr\_Cg\_em2 <- pairs(TrTr\_Cg\_em, adjust="Tukey")  
TrTr\_Cg\_em3 <- as.data.frame(TrTr\_Cg\_em2)  
  
TrTr\_Cg\_em3$signif <- with(TrTr\_Cg\_em3, ifelse(p.value < 0.05, 'TRUE', 'FALSE'))  
TrTr\_Cg\_em3$p.value <- formatC(TrTr\_Cg\_em3$p.value, format = "e")  
  
TrTr\_Cg\_em2

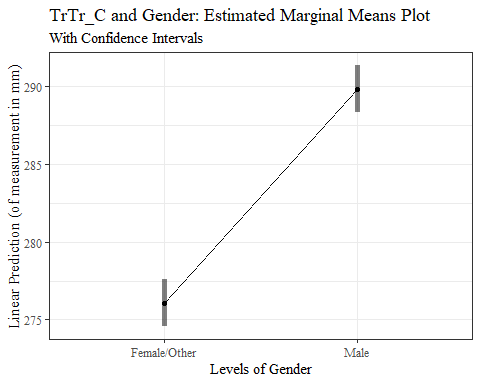
## contrast estimate SE df t.ratio p.value  
## (Female/Other) - Male -13.7 0.586 1669 -23.460 <.0001  
##   
## Results are averaged over the levels of: race\_eth, age\_group

TrTr\_Cg\_em3 <- TrTr\_Cg\_em3 %>%   
 mutate(across(where(is.numeric), round, digits=3))  
  
flextable(TrTr\_Cg\_em3) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("Tukey Pairwise Comparisons: TrTr\_C and Gender") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

**Table** **68**: Tukey Pairwise Comparisons: TrTr\_C and Gender

| **contrast** | **estimate** | **SE** | **df** | **t.ratio** | **p.value** | **signif** |
| --- | --- | --- | --- | --- | --- | --- |
| (Female/Other) - Male | -13.745 | 0.586 | 1,669 | -23.46 | 2.0182e-105 | TRUE |

emmip\_TrTr\_Cg <- emmip(TrTr\_Cout, ~ gender, CIs = TRUE)  
  
emmip\_TrTr\_Cg +   
 theme\_bw()+theme(text=element\_text(family= "Times New Roman"))+  
 labs(title="TrTr\_C and Gender: Estimated Marginal Means Plot",  
 subtitle="With Confidence Intervals",  
 y="Linear Prediction (of measurement in mm)",  
 x="Levels of Gender")



TrTr\_Cr\_em <- emmeans(TrTr\_Cout, ~ race\_eth)  
TrTr\_Cr\_em1 <- as.data.frame(TrTr\_Cr\_em)  
  
TrTr\_Cr\_em

## race\_eth emmean SE df lower.CL upper.CL  
## Asian 281.2 1.3722 1669 278.5 283.9  
## Black 289.2 0.6820 1669 287.9 290.6  
## LatinX 281.7 1.3383 1669 279.0 284.3  
## Other 280.5 2.3075 1669 276.0 285.0  
## white 282.1 0.5482 1669 281.0 283.2  
##   
## Results are averaged over the levels of: gender, age\_group   
## Confidence level used: 0.95

TrTr\_Cr\_em1 <- TrTr\_Cr\_em1 %>%   
 mutate(across(where(is.numeric), round, digits=3))  
  
flextable(TrTr\_Cr\_em1) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("Estimated Marginal Means: TrTr\_C and Race/Ethnicity") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

**Table 69**: Estimated Marginal Means: TrTr\_C and Race/Ethnicity

| **race\_eth** | **emmean** | **SE** | **df** | **lower.CL** | **upper.CL** |
| --- | --- | --- | --- | --- | --- |
| Asian | 281.226 | 1.372 | 1,669 | 278.535 | 283.918 |
| Black | 289.247 | 0.682 | 1,669 | 287.910 | 290.585 |
| LatinX | 281.654 | 1.338 | 1,669 | 279.029 | 284.278 |
| Other | 280.516 | 2.307 | 1,669 | 275.990 | 285.042 |
| white | 282.108 | 0.548 | 1,669 | 281.033 | 283.183 |

TrTr\_Cr\_em2 <- pairs(TrTr\_Cr\_em, adjust="Tukey")  
TrTr\_Cr\_em3 <- as.data.frame(TrTr\_Cr\_em2)  
  
TrTr\_Cr\_em3$signif <- with(TrTr\_Cr\_em3, ifelse(p.value < 0.05, 'TRUE', 'FALSE'))  
TrTr\_Cr\_em3$p.value <- formatC(TrTr\_Cr\_em3$p.value, format = "e")  
  
TrTr\_Cr\_em2

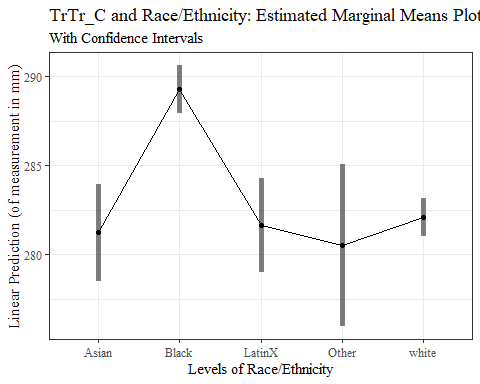
## contrast estimate SE df t.ratio p.value  
## Asian - Black -8.021 1.419 1669 -5.652 <.0001  
## Asian - LatinX -0.427 1.822 1669 -0.234 0.9993  
## Asian - Other 0.710 2.644 1669 0.269 0.9989  
## Asian - white -0.882 1.354 1669 -0.651 0.9664  
## Black - LatinX 7.594 1.394 1669 5.446 <.0001  
## Black - Other 8.731 2.365 1669 3.693 0.0021  
## Black - white 7.139 0.664 1669 10.754 <.0001  
## LatinX - Other 1.138 2.630 1669 0.433 0.9927  
## LatinX - white -0.455 1.328 1669 -0.342 0.9971  
## Other - white -1.592 2.328 1669 -0.684 0.9600  
##   
## Results are averaged over the levels of: gender, age\_group   
## P value adjustment: tukey method for comparing a family of 5 estimates

TrTr\_Cr\_em3 <- TrTr\_Cr\_em3 %>%   
 mutate(across(where(is.numeric), round, digits=3))  
  
flextable(TrTr\_Cr\_em3) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("Tukey Pairwise Comparisons: TrTr\_C and Race/Ethnicity") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

**Table** **70**: Tukey Pairwise Comparisons: TrTr\_C and Race/Ethnicity

| **contrast** | **estimate** | **SE** | **df** | **t.ratio** | **p.value** | **signif** |
| --- | --- | --- | --- | --- | --- | --- |
| Asian - Black | -8.021 | 1.419 | 1,669 | -5.652 | 1.8603e-07 | TRUE |
| Asian - LatinX | -0.427 | 1.822 | 1,669 | -0.234 | 9.9933e-01 | FALSE |
| Asian - Other | 0.710 | 2.644 | 1,669 | 0.269 | 9.9886e-01 | FALSE |
| Asian - white | -0.882 | 1.354 | 1,669 | -0.651 | 9.6644e-01 | FALSE |
| Black - LatinX | 7.594 | 1.394 | 1,669 | 5.446 | 5.8989e-07 | TRUE |
| Black - Other | 8.731 | 2.365 | 1,669 | 3.693 | 2.1323e-03 | TRUE |
| Black - white | 7.139 | 0.664 | 1,669 | 10.754 | 1.6478e-12 | TRUE |
| LatinX - Other | 1.138 | 2.630 | 1,669 | 0.433 | 9.9272e-01 | FALSE |
| LatinX - white | -0.455 | 1.328 | 1,669 | -0.342 | 9.9706e-01 | FALSE |
| Other - white | -1.592 | 2.328 | 1,669 | -0.684 | 9.5999e-01 | FALSE |

emmip\_TrTr\_Cr <- emmip(TrTr\_Cout, ~ race\_eth, CIs = TRUE)  
  
emmip\_TrTr\_Cr +   
 theme\_bw()+theme(text=element\_text(family= "Times New Roman"))+  
 labs(title="TrTr\_C and Race/Ethnicity: Estimated Marginal Means Plot",  
 subtitle="With Confidence Intervals",  
 y="Linear Prediction (of measurement in mm)",  
 x="Levels of Race/Ethnicity")



TrTr\_Ca\_em <- emmeans(TrTr\_Cout, ~ age\_group)  
TrTr\_Ca\_em1 <- as.data.frame(TrTr\_Ca\_em)  
  
TrTr\_Ca\_em

## age\_group emmean SE df lower.CL upper.CL  
## 18-36 280.5 0.6632 1669 279.2 281.9  
## 37-54 282.1 0.6887 1669 280.8 283.5  
## 55-72 286.2 1.4387 1669 283.4 289.0  
##   
## Results are averaged over the levels of: gender, race\_eth   
## Confidence level used: 0.95

TrTr\_Ca\_em1 <- TrTr\_Ca\_em1 %>%   
 mutate(across(where(is.numeric), round, digits=3))  
  
flextable(TrTr\_Ca\_em1) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("Estimated Marginal Means: TrTr\_C and Age Group") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

**Table 71**: Estimated Marginal Means: TrTr\_C and Age Group

| **age\_group** | **emmean** | **SE** | **df** | **lower.CL** | **upper.CL** |
| --- | --- | --- | --- | --- | --- |
| 18-36 | 280.549 | 0.663 | 1,669 | 279.248 | 281.850 |
| 37-54 | 282.112 | 0.689 | 1,669 | 280.762 | 283.463 |
| 55-72 | 286.189 | 1.439 | 1,669 | 283.367 | 289.011 |

TrTr\_Ca\_em2 <- pairs(TrTr\_Ca\_em, adjust="Tukey")  
TrTr\_Ca\_em3 <- as.data.frame(TrTr\_Ca\_em2)  
  
TrTr\_Ca\_em3$signif <- with(TrTr\_Ca\_em3, ifelse(p.value < 0.05, 'TRUE', 'FALSE'))  
TrTr\_Ca\_em3$p.value <- formatC(TrTr\_Ca\_em3$p.value, format = "e")  
  
TrTr\_Ca\_em2

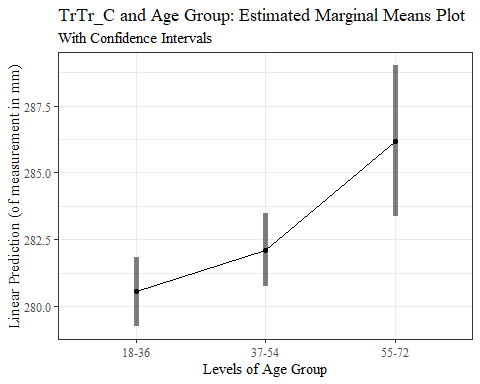
## contrast estimate SE df t.ratio p.value  
## (18-36) - (37-54) -1.56 0.589 1669 -2.654 0.0219  
## (18-36) - (55-72) -5.64 1.425 1669 -3.957 0.0002  
## (37-54) - (55-72) -4.08 1.430 1669 -2.851 0.0123  
##   
## Results are averaged over the levels of: gender, race\_eth   
## P value adjustment: tukey method for comparing a family of 3 estimates

TrTr\_Ca\_em3 <- TrTr\_Ca\_em3 %>%   
 mutate(across(where(is.numeric), round, digits=3))  
  
flextable(TrTr\_Ca\_em3) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("Tukey Pairwise Comparisons: TrTr\_C and Age Group") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

**Table** **72**: Tukey Pairwise Comparisons: TrTr\_C and Age Group

| **contrast** | **estimate** | **SE** | **df** | **t.ratio** | **p.value** | **signif** |
| --- | --- | --- | --- | --- | --- | --- |
| (18-36) - (37-54) | -1.563 | 0.589 | 1,669 | -2.654 | 2.1890e-02 | TRUE |
| (18-36) - (55-72) | -5.640 | 1.425 | 1,669 | -3.957 | 2.3296e-04 | TRUE |
| (37-54) - (55-72) | -4.076 | 1.430 | 1,669 | -2.851 | 1.2277e-02 | TRUE |

emmip\_TrTr\_Ca <- emmip(TrTr\_Cout, ~ age\_group, CIs = TRUE)  
  
emmip\_TrTr\_Ca +   
 theme\_bw()+theme(text=element\_text(family= "Times New Roman"))+  
 labs(title="TrTr\_C and Age Group: Estimated Marginal Means Plot",  
 subtitle="With Confidence Intervals",  
 y="Linear Prediction (of measurement in mm)",  
 x="Levels of Age Group")



TrTr\_Lout <- aov(TrTr\_L ~ gender+race\_eth+age\_group, data=chosen\_nona1)  
summary(TrTr\_Lout)

## Df Sum Sq Mean Sq F value Pr(>F)   
## gender 1 37746 37746 1124.034 < 2e-16 \*\*\*  
## race\_eth 4 2343 586 17.440 4.98e-14 \*\*\*  
## age\_group 2 450 225 6.693 0.00127 \*\*   
## Residuals 1669 56046 34   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

TrTr\_Lout\_data <- as.data.frame(tidy(TrTr\_Lout))

TrTr\_Lout\_data <- rename(TrTr\_Lout\_data, f.statistic = statistic)  
TrTr\_Lout\_data$signif <- with(TrTr\_Lout\_data, ifelse(p.value < 0.05, 'TRUE', 'FALSE'))  
TrTr\_Lout\_data$p.value <- formatC(TrTr\_Lout\_data$p.value, format = "e")  
  
TrTr\_Lout\_data <- TrTr\_Lout\_data %>%   
 mutate(across(where(is.numeric), round, digits=3))  
  
#Autofit Width Table TNR  
flextable(TrTr\_Lout\_data) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("TrTr\_L Additive Anova Model Findings") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

**Table** **73**: TrTr\_L Additive Anova Model Findings

| **term** | **df** | **sumsq** | **meansq** | **f.statistic** | **p.value** | **signif** |
| --- | --- | --- | --- | --- | --- | --- |
| gender | 1 | 37,745.911 | 37,745.911 | 1,124.034 | 7.5367e-189 | TRUE |
| race\_eth | 4 | 2,342.601 | 585.650 | 17.440 | 4.9816e-14 | TRUE |
| age\_group | 2 | 449.507 | 224.753 | 6.693 | 1.2732e-03 | TRUE |
| Residuals | 1,669 | 56,046.305 | 33.581 |  | NA |  |

TrTr\_Lg\_em <- emmeans(TrTr\_Lout, ~ gender)  
TrTr\_Lg\_em1 <- as.data.frame(TrTr\_Lg\_em)  
  
TrTr\_Lg\_em

## gender emmean SE df lower.CL upper.CL  
## Female/Other 142.4 0.3790 1669 141.7 143.2  
## Male 152.1 0.3815 1669 151.3 152.8  
##   
## Results are averaged over the levels of: race\_eth, age\_group   
## Confidence level used: 0.95

TrTr\_Lg\_em1 <- TrTr\_Lg\_em1 %>%   
 mutate(across(where(is.numeric), round, digits=3))  
  
flextable(TrTr\_Lg\_em1) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("Estimated Marginal Means: TrTr\_L and Gender") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

**Table 74**: Estimated Marginal Means: TrTr\_L and Gender

| **gender** | **emmean** | **SE** | **df** | **lower.CL** | **upper.CL** |
| --- | --- | --- | --- | --- | --- |
| Female/Other | 142.441 | 0.379 | 1,669 | 141.698 | 143.184 |
| Male | 152.058 | 0.382 | 1,669 | 151.309 | 152.806 |

TrTr\_Lg\_em2 <- pairs(TrTr\_Lg\_em, adjust="Tukey")  
TrTr\_Lg\_em3 <- as.data.frame(TrTr\_Lg\_em2)  
  
TrTr\_Lg\_em3$signif <- with(TrTr\_Lg\_em3, ifelse(p.value < 0.05, 'TRUE', 'FALSE'))  
TrTr\_Lg\_em3$p.value <- formatC(TrTr\_Lg\_em3$p.value, format = "e")  
  
TrTr\_Lg\_em2

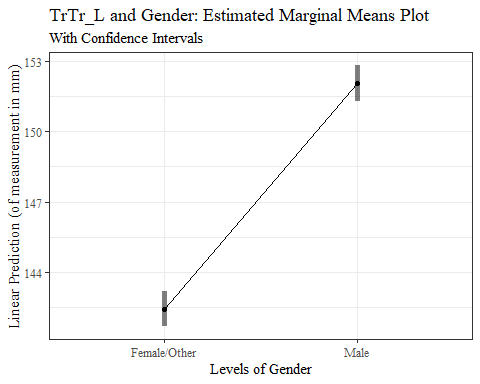
## contrast estimate SE df t.ratio p.value  
## (Female/Other) - Male -9.62 0.29 1669 -33.130 <.0001  
##   
## Results are averaged over the levels of: race\_eth, age\_group

TrTr\_Lg\_em3 <- TrTr\_Lg\_em3 %>%   
 mutate(across(where(is.numeric), round, digits=3))  
  
flextable(TrTr\_Lg\_em3) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("Tukey Pairwise Comparisons: TrTr\_L and Gender") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

**Table** **75**: Tukey Pairwise Comparisons: TrTr\_L and Gender

| **contrast** | **estimate** | **SE** | **df** | **t.ratio** | **p.value** | **signif** |
| --- | --- | --- | --- | --- | --- | --- |
| (Female/Other) - Male | -9.617 | 0.29 | 1,669 | -33.13 | 2.1351e-185 | TRUE |

emmip\_TrTr\_Lg <- emmip(TrTr\_Lout, ~ gender, CIs = TRUE)  
  
emmip\_TrTr\_Lg +   
 theme\_bw()+theme(text=element\_text(family= "Times New Roman"))+  
 labs(title="TrTr\_L and Gender: Estimated Marginal Means Plot",  
 subtitle="With Confidence Intervals",  
 y="Linear Prediction (of measurement in mm)",  
 x="Levels of Gender")



TrTr\_Lr\_em <- emmeans(TrTr\_Lout, ~ race\_eth)  
TrTr\_Lr\_em1 <- as.data.frame(TrTr\_Lr\_em)  
  
TrTr\_Lr\_em

## race\_eth emmean SE df lower.CL upper.CL  
## Asian 147.4 0.6798 1669 146.1 148.7  
## Black 148.9 0.3379 1669 148.3 149.6  
## LatinX 146.8 0.6631 1669 145.5 148.1  
## Other 146.8 1.1432 1669 144.6 149.1  
## white 146.3 0.2716 1669 145.7 146.8  
##   
## Results are averaged over the levels of: gender, age\_group   
## Confidence level used: 0.95

TrTr\_Lr\_em1 <- TrTr\_Lr\_em1 %>%   
 mutate(across(where(is.numeric), round, digits=3))  
  
flextable(TrTr\_Lr\_em1) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("Estimated Marginal Means: TrTr\_L and Race/Ethnicity") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

**Table 76**: Estimated Marginal Means: TrTr\_L and Race/Ethnicity

| **race\_eth** | **emmean** | **SE** | **df** | **lower.CL** | **upper.CL** |
| --- | --- | --- | --- | --- | --- |
| Asian | 147.408 | 0.680 | 1,669 | 146.074 | 148.741 |
| Black | 148.920 | 0.338 | 1,669 | 148.258 | 149.583 |
| LatinX | 146.844 | 0.663 | 1,669 | 145.543 | 148.144 |
| Other | 146.813 | 1.143 | 1,669 | 144.571 | 149.055 |
| white | 146.262 | 0.272 | 1,669 | 145.729 | 146.795 |

TrTr\_Lr\_em2 <- pairs(TrTr\_Lr\_em, adjust="Tukey")  
TrTr\_Lr\_em3 <- as.data.frame(TrTr\_Lr\_em2)  
  
TrTr\_Lr\_em3$signif <- with(TrTr\_Lr\_em3, ifelse(p.value < 0.05, 'TRUE', 'FALSE'))  
TrTr\_Lr\_em3$p.value <- formatC(TrTr\_Lr\_em3$p.value, format = "e")  
  
TrTr\_Lr\_em2

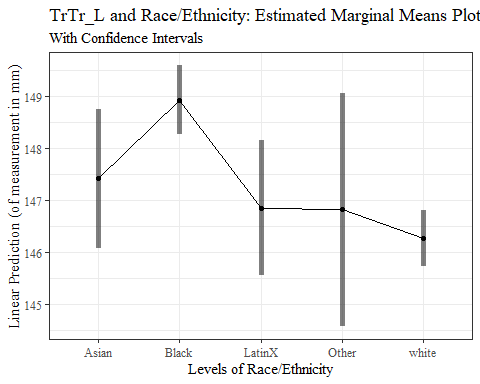
## contrast estimate SE df t.ratio p.value  
## Asian - Black -1.5127 0.703 1669 -2.151 0.1991  
## Asian - LatinX 0.5639 0.903 1669 0.625 0.9712  
## Asian - Other 0.5948 1.310 1669 0.454 0.9912  
## Asian - white 1.1457 0.671 1669 1.708 0.4293  
## Black - LatinX 2.0766 0.691 1669 3.006 0.0225  
## Black - Other 2.1075 1.171 1669 1.799 0.3744  
## Black - white 2.6584 0.329 1669 8.082 <.0001  
## LatinX - Other 0.0309 1.303 1669 0.024 1.0000  
## LatinX - white 0.5818 0.658 1669 0.884 0.9029  
## Other - white 0.5509 1.153 1669 0.478 0.9894  
##   
## Results are averaged over the levels of: gender, age\_group   
## P value adjustment: tukey method for comparing a family of 5 estimates

TrTr\_Lr\_em3 <- TrTr\_Lr\_em3 %>%   
 mutate(across(where(is.numeric), round, digits=3))  
  
flextable(TrTr\_Lr\_em3) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("Tukey Pairwise Comparisons: TrTr\_L and Race/Ethnicity") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

**Table** **77**: Tukey Pairwise Comparisons: TrTr\_L and Race/Ethnicity

| **contrast** | **estimate** | **SE** | **df** | **t.ratio** | **p.value** | **signif** |
| --- | --- | --- | --- | --- | --- | --- |
| Asian - Black | -1.513 | 0.703 | 1,669 | -2.151 | 1.9907e-01 | FALSE |
| Asian - LatinX | 0.564 | 0.903 | 1,669 | 0.625 | 9.7116e-01 | FALSE |
| Asian - Other | 0.595 | 1.310 | 1,669 | 0.454 | 9.9124e-01 | FALSE |
| Asian - white | 1.146 | 0.671 | 1,669 | 1.708 | 4.2933e-01 | FALSE |
| Black - LatinX | 2.077 | 0.691 | 1,669 | 3.006 | 2.2532e-02 | TRUE |
| Black - Other | 2.107 | 1.171 | 1,669 | 1.799 | 3.7442e-01 | FALSE |
| Black - white | 2.658 | 0.329 | 1,669 | 8.082 | 1.6780e-12 | TRUE |
| LatinX - Other | 0.031 | 1.303 | 1,669 | 0.024 | 1.0000e+00 | FALSE |
| LatinX - white | 0.582 | 0.658 | 1,669 | 0.884 | 9.0285e-01 | FALSE |
| Other - white | 0.551 | 1.153 | 1,669 | 0.478 | 9.8938e-01 | FALSE |

emmip\_TrTr\_Lr <- emmip(TrTr\_Lout, ~ race\_eth, CIs = TRUE)  
  
emmip\_TrTr\_Lr +   
 theme\_bw()+theme(text=element\_text(family= "Times New Roman"))+  
 labs(title="TrTr\_L and Race/Ethnicity: Estimated Marginal Means Plot",  
 subtitle="With Confidence Intervals",  
 y="Linear Prediction (of measurement in mm)",  
 x="Levels of Race/Ethnicity")



TrTr\_La\_em <- emmeans(TrTr\_Lout, ~ age\_group)  
TrTr\_La\_em1 <- as.data.frame(TrTr\_La\_em)  
  
TrTr\_La\_em

## age\_group emmean SE df lower.CL upper.CL  
## 18-36 146.3 0.3286 1669 145.7 146.9  
## 37-54 147.1 0.3412 1669 146.5 147.8  
## 55-72 148.3 0.7128 1669 146.9 149.7  
##   
## Results are averaged over the levels of: gender, race\_eth   
## Confidence level used: 0.95

TrTr\_La\_em1 <- TrTr\_La\_em1 %>%   
 mutate(across(where(is.numeric), round, digits=3))  
  
flextable(TrTr\_La\_em1) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("Estimated Marginal Means: TrTr\_L and Age Group") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

**Table 78**: Estimated Marginal Means: TrTr\_L and Age Group

| **age\_group** | **emmean** | **SE** | **df** | **lower.CL** | **upper.CL** |
| --- | --- | --- | --- | --- | --- |
| 18-36 | 146.303 | 0.329 | 1,669 | 145.659 | 146.948 |
| 37-54 | 147.121 | 0.341 | 1,669 | 146.452 | 147.791 |
| 55-72 | 148.323 | 0.713 | 1,669 | 146.925 | 149.721 |

TrTr\_La\_em2 <- pairs(TrTr\_La\_em, adjust="Tukey")  
TrTr\_La\_em3 <- as.data.frame(TrTr\_La\_em2)  
  
TrTr\_La\_em3$signif <- with(TrTr\_La\_em3, ifelse(p.value < 0.05, 'TRUE', 'FALSE'))  
TrTr\_La\_em3$p.value <- formatC(TrTr\_La\_em3$p.value, format = "e")  
  
TrTr\_La\_em2

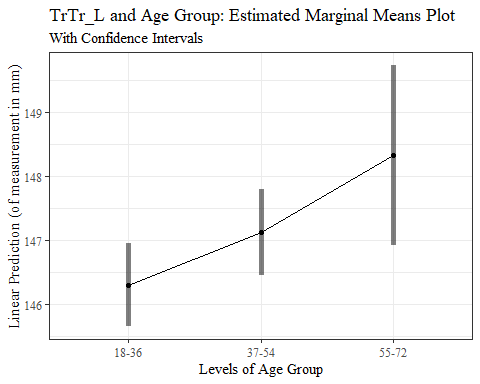
## contrast estimate SE df t.ratio p.value  
## (18-36) - (37-54) -0.818 0.292 1669 -2.803 0.0142  
## (18-36) - (55-72) -2.020 0.706 1669 -2.861 0.0119  
## (37-54) - (55-72) -1.202 0.708 1669 -1.696 0.2069  
##   
## Results are averaged over the levels of: gender, race\_eth   
## P value adjustment: tukey method for comparing a family of 3 estimates

TrTr\_La\_em3 <- TrTr\_La\_em3 %>%   
 mutate(across(where(is.numeric), round, digits=3))  
  
flextable(TrTr\_La\_em3) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("Tukey Pairwise Comparisons: TrTr\_L and Age Group") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

**Table** **79**: Tukey Pairwise Comparisons: TrTr\_L and Age Group

| **contrast** | **estimate** | **SE** | **df** | **t.ratio** | **p.value** | **signif** |
| --- | --- | --- | --- | --- | --- | --- |
| (18-36) - (37-54) | -0.818 | 0.292 | 1,669 | -2.803 | 1.4161e-02 | TRUE |
| (18-36) - (55-72) | -2.020 | 0.706 | 1,669 | -2.861 | 1.1912e-02 | TRUE |
| (37-54) - (55-72) | -1.202 | 0.708 | 1,669 | -1.696 | 2.0694e-01 | FALSE |

emmip\_TrTr\_La <- emmip(TrTr\_Lout, ~ age\_group, CIs = TRUE)  
  
emmip\_TrTr\_La +   
 theme\_bw()+theme(text=element\_text(family= "Times New Roman"))+  
 labs(title="TrTr\_L and Age Group: Estimated Marginal Means Plot",  
 subtitle="With Confidence Intervals",  
 y="Linear Prediction (of measurement in mm)",  
 x="Levels of Age Group")



#gender   
AA\_Cg\_em1$measure <- "AA\_C"  
BiW\_Lg\_em1$measure <- "BiW\_L"  
BiW\_Cg\_em1$measure <- "BiW\_C"  
GoSub\_Cg\_em1$measure <- "GoSub\_C"  
NRB\_Lg\_em1$measure <- "NRB\_L"  
ProS\_Lg\_em1$measure <- "ProS\_L"  
SelP\_Lg\_em1$measure <- "SelP\_L"  
SelM\_Lg\_em1$measure <- "SelM\_L"  
SnasM\_Cg\_em1$measure <- "SnasM\_C"  
TrSman\_Cg\_em1$measure <- "TrSman\_C"  
TrTr\_Cg\_em1$measure <- "TrTr\_C"  
TrTr\_Lg\_em1$measure <- "TrTr\_L"  
  
gender\_means\_data <- rbind(AA\_Cg\_em1, BiW\_Lg\_em1, BiW\_Cg\_em1, GoSub\_Cg\_em1, NRB\_Lg\_em1,  
 ProS\_Lg\_em1, SelP\_Lg\_em1, SelM\_Lg\_em1, SnasM\_Cg\_em1, TrSman\_Cg\_em1,  
 TrTr\_Cg\_em1, TrTr\_Lg\_em1)  
  
#write\_xlsx(gender\_means\_data, "C:\\Users\\19177\\OneDrive - Colostate\\Desktop\\Dissertation\\headscan\_dissertation\\gender\_means\_data.xlsx")

#race\_eth  
AA\_Cr\_em1$measure <- "AA\_C"  
BiW\_Lr\_em1$measure <- "BiW\_L"  
BiW\_Cr\_em1$measure <- "BiW\_C"  
GoSub\_Cr\_em1$measure <- "GoSub\_C"  
NRB\_Lr\_em1$measure <- "NRB\_L"  
ProS\_Lr\_em1$measure <- "ProS\_L"  
SelP\_Lr\_em1$measure <- "SelP\_L"  
SelM\_Lr\_em1$measure <- "SelM\_L"  
SnasM\_Cr\_em1$measure <- "SnasM\_C"  
TrSman\_Cr\_em1$measure <- "TrSman\_C"  
TrTr\_Cr\_em1$measure <- "TrTr\_C"  
TrTr\_Lr\_em1$measure <- "TrTr\_L"  
  
race\_means\_data <- rbind(AA\_Cr\_em1, BiW\_Lr\_em1, BiW\_Cr\_em1, GoSub\_Cr\_em1, NRB\_Lr\_em1,  
 ProS\_Lr\_em1, SelP\_Lr\_em1, SelM\_Lr\_em1, SnasM\_Cr\_em1, TrSman\_Cr\_em1,  
 TrTr\_Cr\_em1, TrTr\_Lr\_em1)  
  
#write\_xlsx(race\_means\_data, "C:\\Users\\19177\\OneDrive - Colostate\\Desktop\\Dissertation\\headscan\_dissertation\\race\_means\_data.xlsx")

#age   
AA\_Ca\_em1$measure <- "AA\_C"  
BiW\_La\_em1$measure <- "BiW\_L"  
GoSub\_Ca\_em1$measure <- "GoSub\_C"  
ProS\_La\_em1$measure <- "ProS\_L"  
SelP\_La\_em1$measure <- "SelP\_L"  
SelM\_La\_em1$measure <- "SelM\_L"  
TrSman\_Ca\_em1$measure <- "TrSman\_C"  
TrTr\_Ca\_em1$measure <- "TrTr\_C"  
TrTr\_La\_em1$measure <- "TrTr\_L"  
  
age\_means\_data <- rbind(AA\_Ca\_em1, BiW\_La\_em1, GoSub\_Ca\_em1,  
 ProS\_La\_em1, SelP\_La\_em1, SelM\_La\_em1, TrSman\_Ca\_em1,  
 TrTr\_Ca\_em1, TrTr\_La\_em1)  
  
#write\_xlsx(age\_means\_data, "C:\\Users\\19177\\OneDrive - Colostate\\Desktop\\Dissertation\\headscan\_dissertation\\age\_means\_data.xlsx")

#gender   
AA\_Cg\_em3$measure <- "AA\_C"  
BiW\_Lg\_em3$measure <- "BiW\_L"  
BiW\_Cg\_em3$measure <- "BiW\_C"  
GoSub\_Cg\_em3$measure <- "GoSub\_C"  
NRB\_Lg\_em3$measure <- "NRB\_L"  
ProS\_Lg\_em3$measure <- "ProS\_L"  
SelP\_Lg\_em3$measure <- "SelP\_L"  
SelM\_Lg\_em3$measure <- "SelM\_L"  
SnasM\_Cg\_em3$measure <- "SnasM\_C"  
TrSman\_Cg\_em3$measure <- "TrSman\_C"  
TrTr\_Cg\_em3$measure <- "TrTr\_C"  
TrTr\_Lg\_em3$measure <- "TrTr\_L"  
  
gender\_est\_data <- rbind(AA\_Cg\_em3, BiW\_Lg\_em3, BiW\_Cg\_em3, GoSub\_Cg\_em3, NRB\_Lg\_em3,  
 ProS\_Lg\_em3, SelP\_Lg\_em3, SelM\_Lg\_em3, SnasM\_Cg\_em3, TrSman\_Cg\_em3,  
 TrTr\_Cg\_em3, TrTr\_Lg\_em3)  
  
#write\_xlsx(gender\_est\_data, "C:\\Users\\19177\\OneDrive - Colostate\\Desktop\\Dissertation\\headscan\_dissertation\\gender\_est\_data.xlsx")

#race\_eth  
AA\_Cr\_em3$measure <- "AA\_C"  
BiW\_Lr\_em3$measure <- "BiW\_L"  
BiW\_Cr\_em3$measure <- "BiW\_C"  
GoSub\_Cr\_em3$measure <- "GoSub\_C"  
NRB\_Lr\_em3$measure <- "NRB\_L"  
ProS\_Lr\_em3$measure <- "ProS\_L"  
SelP\_Lr\_em3$measure <- "SelP\_L"  
SelM\_Lr\_em3$measure <- "SelM\_L"  
SnasM\_Cr\_em3$measure <- "SnasM\_C"  
TrSman\_Cr\_em3$measure <- "TrSman\_C"  
TrTr\_Cr\_em3$measure <- "TrTr\_C"  
TrTr\_Lr\_em3$measure <- "TrTr\_L"  
  
race\_est\_data <- rbind(AA\_Cr\_em3, BiW\_Lr\_em3, BiW\_Cr\_em3, GoSub\_Cr\_em3, NRB\_Lr\_em3,  
 ProS\_Lr\_em3, SelP\_Lr\_em3, SelM\_Lr\_em3, SnasM\_Cr\_em3, TrSman\_Cr\_em3,  
 TrTr\_Cr\_em3, TrTr\_Lr\_em3)  
  
#write\_xlsx(race\_est\_data, "C:\\Users\\19177\\OneDrive - Colostate\\Desktop\\Dissertation\\headscan\_dissertation\\race\_est\_data.xlsx")

#age   
AA\_Ca\_em3$measure <- "AA\_C"  
BiW\_La\_em3$measure <- "BiW\_L"  
GoSub\_Ca\_em3$measure <- "GoSub\_C"  
ProS\_La\_em3$measure <- "ProS\_L"  
SelP\_La\_em3$measure <- "SelP\_L"  
SelM\_La\_em3$measure <- "SelM\_L"  
TrSman\_Ca\_em3$measure <- "TrSman\_C"  
TrTr\_Ca\_em3$measure <- "TrTr\_C"  
TrTr\_La\_em3$measure <- "TrTr\_L"  
  
age\_est\_data <- rbind(AA\_Ca\_em3, BiW\_La\_em3, GoSub\_Ca\_em3,  
 ProS\_La\_em3, SelP\_La\_em3, SelM\_La\_em3,   
 TrSman\_Ca\_em3, TrTr\_Ca\_em3, TrTr\_La\_em3)  
  
#write\_xlsx(age\_est\_data, "C:\\Users\\19177\\OneDrive - Colostate\\Desktop\\Dissertation\\headscan\_dissertation\\age\_est\_data.xlsx")