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(officer)

##   
## Attaching package: 'officer'  
##   
## The following object is masked from 'package:readxl':  
##   
## read\_xlsx

library(flextable)

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

library(extrafont)

## Registering fonts with R

library(writexl)  
library(rstatix)

##   
## Attaching package: 'rstatix'  
##   
## The following object is masked from 'package:stats':  
##   
## filter

library(corrr)  
library(corrplot)

## corrplot 0.92 loaded

library(car)

## 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(heplots)  
library(broom)  
library(emmeans)

#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")  
  
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,] 45426.1778 -4536.996 -8173.659 12763.512 -605.98683 9857.2281  
## [2,] -4536.9958 236075.452 166394.959 -25315.575 21240.62179 -6613.6163  
## [3,] -8173.6593 166394.959 141187.104 6871.155 20034.07392 -6444.7891  
## [4,] 12763.5116 -25315.575 6871.155 270930.351 4224.69864 11914.6661  
## [5,] -605.9868 21240.622 20034.074 4224.699 34604.61889 -839.8211  
## [6,] 9857.2281 -6613.616 -6444.789 11914.666 -839.82110 9250.6332  
## [7,] 9427.7899 13364.605 4868.050 -7733.916 -99.91837 1435.7996  
## [8,] -494.4294 79069.216 61389.361 13706.901 20562.03800 1913.4566  
## [9,] -12201.7626 100131.058 82724.340 -1046.163 25334.86661 -5464.4324  
## [10,] 16107.4520 41764.121 54322.190 178748.811 17634.75751 8497.9732  
## [11,] 24867.9107 79580.144 79708.714 89978.663 15062.85260 5829.5129  
## [12,] 11523.2278 28586.126 33420.114 48977.659 4753.70717 3697.4119  
## [,7] [,8] [,9] [,10] [,11] [,12]  
## [1,] 9427.78989 -494.4294 -12201.763 16107.452 24867.911 11523.228  
## [2,] 13364.60492 79069.2160 100131.058 41764.121 79580.144 28586.126  
## [3,] 4868.05005 61389.3607 82724.340 54322.190 79708.714 33420.114  
## [4,] -7733.91590 13706.9008 -1046.163 178748.811 89978.663 48977.659  
## [5,] -99.91837 20562.0380 25334.867 17634.758 15062.853 4753.707  
## [6,] 1435.79958 1913.4566 -5464.432 8497.973 5829.513 3697.412  
## [7,] 24127.97836 22968.7030 7326.518 1153.815 9490.355 1253.263  
## [8,] 22968.70295 114591.5877 111505.218 41928.383 44043.878 11007.662  
## [9,] 7326.51800 111505.2181 149041.633 31784.081 33860.879 6886.195  
## [10,] 1153.81513 41928.3829 31784.081 202547.558 123831.934 60867.866  
## [11,] 9490.35468 44043.8777 33860.879 123831.934 228168.780 68069.020  
## [12,] 1253.26283 11007.6615 6886.195 60867.866 68069.020 56012.417  
##   
## ------------------------------------------  
##   
## Term: (Intercept)   
##   
## Sum of squares and products for the hypothesis:  
## [,1] [,2] [,3] [,4] [,5] [,6] [,7]  
## [1,] 66891.72 139315.95 116368.07 113040.69 19149.992 19750.393 45592.93  
## [2,] 139315.95 290154.53 242360.77 235430.82 39883.851 41134.311 94956.78  
## [3,] 116368.07 242360.77 202439.52 196651.06 33314.251 34358.738 79315.66  
## [4,] 113040.69 235430.82 196651.06 191028.11 32361.679 33376.300 77047.75  
## [5,] 19149.99 39883.85 33314.25 32361.68 5482.326 5654.210 13052.50  
## [6,] 19750.39 41134.31 34358.74 33376.30 5654.210 5831.484 13461.73  
## [7,] 45592.93 94956.78 79315.66 77047.75 13052.501 13461.730 31075.82  
## [8,] 124631.52 259571.12 216815.01 210615.50 35679.939 36798.596 84947.97  
## [9,] 82256.18 171315.64 143096.82 139005.18 23548.582 24286.890 56065.24  
## [10,] 167835.07 349551.53 291974.00 283625.44 48048.402 49554.841 114395.21  
## [11,] 304672.20 634543.40 530022.49 514867.28 87222.607 89957.258 207662.45  
## [12,] 157924.64 328910.99 274733.33 266877.74 45211.209 46628.695 107640.33  
## [,8] [,9] [,10] [,11] [,12]  
## [1,] 124631.52 82256.18 167835.07 304672.20 157924.64  
## [2,] 259571.12 171315.64 349551.53 634543.40 328910.99  
## [3,] 216815.01 143096.82 291974.00 530022.49 274733.33  
## [4,] 210615.50 139005.18 283625.44 514867.28 266877.74  
## [5,] 35679.94 23548.58 48048.40 87222.61 45211.21  
## [6,] 36798.60 24286.89 49554.84 89957.26 46628.70  
## [7,] 84947.97 56065.24 114395.21 207662.45 107640.33  
## [8,] 232211.32 153258.31 312707.45 567660.07 294242.50  
## [9,] 153258.31 101149.72 206385.36 374652.82 194198.58  
## [10,] 312707.45 206385.36 421107.60 764439.63 396241.76  
## [11,] 567660.07 374652.82 764439.63 1387692.71 719300.50  
## [12,] 294242.50 194198.58 396241.76 719300.50 372844.22  
##   
## Multivariate Tests: (Intercept)  
## Df test stat approx F num Df den Df Pr(>F)   
## Pillai 1 0.906984 1346.429 12 1657 < 2.22e-16 \*\*\*  
## Wilks 1 0.093016 1346.429 12 1657 < 2.22e-16 \*\*\*  
## Hotelling-Lawley 1 9.750841 1346.429 12 1657 < 2.22e-16 \*\*\*  
## Roy 1 9.750841 1346.429 12 1657 < 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,] 16581.188 22485.992 9250.108 29342.358 -1842.2283 2989.4758 9403.361  
## [2,] 22485.992 30624.093 12659.208 39566.745 -2500.2173 4073.7061 12875.672  
## [3,] 9250.108 12659.208 5261.671 16171.017 -1029.4330 1685.0327 5354.774  
## [4,] 29342.358 39566.745 16171.017 52312.155 -3256.6892 5256.4008 16427.338  
## [5,] -1842.228 -2500.217 -1029.433 -3256.689 204.7070 -332.4338 -1046.589  
## [6,] 2989.476 4073.706 1685.033 5256.401 -332.4338 541.9360 1713.962  
## [7,] 9403.361 12875.672 5354.774 16427.338 -1046.5885 1713.9622 5449.866  
## [8,] 20306.145 27545.109 11334.881 35920.931 -2256.1981 3662.2110 11523.068  
## [9,] 13255.767 17874.699 7305.402 23632.754 -1471.2480 2374.6341 7421.194  
## [10,] 35967.907 48719.639 20015.135 63747.583 -3995.3123 6476.2000 20343.802  
## [11,] 35369.153 47993.791 19757.005 62539.620 -3930.0719 6381.2063 20085.836  
## [12,] 24724.928 33584.626 13841.516 43659.265 -2747.8428 4465.9796 14073.663  
## [,8] [,9] [,10] [,11] [,12]  
## [1,] 20306.145 13255.767 35967.907 35369.153 24724.928  
## [2,] 27545.109 17874.699 48719.639 47993.791 33584.626  
## [3,] 11334.881 7305.402 20015.135 19757.005 13841.516  
## [4,] 35920.931 23632.754 63747.583 62539.620 43659.265  
## [5,] -2256.198 -1471.248 -3995.312 -3930.072 -2747.843  
## [6,] 3662.211 2374.634 6476.200 6381.206 4465.980  
## [7,] 11523.068 7421.194 20343.802 20085.836 14073.663  
## [8,] 24868.361 16227.714 44044.745 43316.528 30282.584  
## [9,] 16227.714 10676.430 28798.772 28253.021 19723.579  
## [10,] 44044.745 28798.772 78046.439 76710.025 53609.390  
## [11,] 43316.528 28253.021 76710.025 75452.075 52752.720  
## [12,] 30282.584 19723.579 53609.390 52752.720 36891.413  
##   
## Multivariate Tests: gender  
## Df test stat approx F num Df den Df Pr(>F)   
## Pillai 2 0.6162445 61.53142 24 3316 < 2.22e-16 \*\*\*  
## Wilks 2 0.3911342 82.70615 24 3314 < 2.22e-16 \*\*\*  
## Hotelling-Lawley 2 1.5378027 106.10839 24 3312 < 2.22e-16 \*\*\*  
## Roy 2 1.5254359 210.76440 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] [,7]  
## [1,] 680.74728 1447.0361 1049.635 1617.771 648.956 -57.13336 -130.3399  
## [2,] 1447.03613 3095.7828 2323.880 3455.904 1414.988 -176.70760 -296.2615  
## [3,] 1049.63459 2323.8803 7164.172 6685.782 3646.412 -2413.94326 -2812.4643  
## [4,] 1617.77118 3455.9041 6685.782 7672.772 3395.261 -1686.01591 -2436.2396  
## [5,] 648.95603 1414.9881 3646.412 3395.261 1943.219 -1210.57750 -1353.9822  
## [6,] -57.13336 -176.7076 -2413.943 -1686.016 -1210.578 1045.49243 1058.4043  
## [7,] -130.33994 -296.2615 -2812.464 -2436.240 -1353.982 1058.40434 1300.6188  
## [8,] 1679.69090 3546.2680 4243.652 5423.984 2403.834 -777.96358 -1174.7784  
## [9,] 2454.90668 5272.8285 12141.130 12437.702 6352.904 -3621.02625 -4525.3091  
## [10,] 1674.55546 3562.2270 7010.448 7887.582 3622.831 -1821.97146 -2558.5919  
## [11,] 2024.19608 4328.9994 10745.431 11174.632 5510.483 -3179.36099 -4162.9563  
## [12,] 432.27943 958.7441 3920.165 3557.995 1961.212 -1378.48253 -1639.0904  
## [,8] [,9] [,10] [,11] [,12]  
## [1,] 1679.6909 2454.907 1674.555 2024.196 432.2794  
## [2,] 3546.2680 5272.828 3562.227 4328.999 958.7441  
## [3,] 4243.6520 12141.130 7010.448 10745.431 3920.1649  
## [4,] 5423.9837 12437.702 7887.582 11174.632 3557.9945  
## [5,] 2403.8343 6352.904 3622.831 5510.483 1961.2121  
## [6,] -777.9636 -3621.026 -1821.971 -3179.361 -1378.4825  
## [7,] -1174.7784 -4525.309 -2558.592 -4162.956 -1639.0904  
## [8,] 4786.3098 8792.585 5676.909 7574.193 2079.8489  
## [9,] 8792.5853 21842.217 13072.297 19283.497 6531.2123  
## [10,] 5676.9092 13072.297 8181.411 11677.873 3738.7975  
## [11,] 7574.1932 19283.497 11677.873 17248.412 5856.8268  
## [12,] 2079.8489 6531.212 3738.798 5856.827 2196.6305  
##   
## Multivariate Tests: race\_eth  
## Df test stat approx F num Df den Df Pr(>F)   
## Pillai 4 0.4562743 17.81118 48 6640.000 < 2.22e-16 \*\*\*  
## Wilks 4 0.5811090 20.12944 48 6384.976 < 2.22e-16 \*\*\*  
## Hotelling-Lawley 4 0.6575060 22.67711 48 6622.000 < 2.22e-16 \*\*\*  
## Roy 4 0.5467476 75.63342 12 1660.000 < 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,] 2227.8704 -415.34059 -929.07137 7616.427 -439.30740 901.7840  
## [2,] -415.3406 466.68115 449.17138 -1256.170 101.19229 -109.3665  
## [3,] -929.0714 449.17138 583.09364 -3060.122 196.87866 -334.4103  
## [4,] 7616.4271 -1256.17046 -3060.12163 26107.193 -1493.74523 3107.6485  
## [5,] -439.3074 101.19229 196.87866 -1493.745 87.58197 -174.9082  
## [6,] 901.7840 -109.36654 -334.41030 3107.648 -174.90824 373.8867  
## [7,] 583.9429 -83.33099 -225.41497 2007.069 -113.88053 240.2188  
## [8,] 865.6992 228.42782 -84.64638 3123.564 -151.38402 409.2511  
## [9,] -537.0828 462.17036 480.65164 -1683.817 123.84983 -162.7512  
## [10,] 6320.0106 -945.07239 -2470.27925 21704.330 -1234.66848 2593.3691  
## [11,] 2085.1607 -902.82143 -1234.02852 6912.271 -436.64665 766.4237  
## [12,] 949.3840 -303.75478 -485.78405 3192.334 -193.48903 365.1528  
## [,7] [,8] [,9] [,10] [,11] [,12]  
## [1,] 583.94290 865.69918 -537.0828 6320.0106 2085.1607 949.3840  
## [2,] -83.33099 228.42782 462.1704 -945.0724 -902.8214 -303.7548  
## [3,] -225.41497 -84.64638 480.6516 -2470.2792 -1234.0285 -485.7841  
## [4,] 2007.06900 3123.56382 -1683.8170 21704.3296 6912.2709 3192.3336  
## [5,] -113.88053 -151.38402 123.8498 -1234.6685 -436.6467 -193.4890  
## [6,] 240.21882 409.25109 -162.7512 2593.3691 766.4237 365.1528  
## [7,] 154.73104 252.47732 -117.0253 1671.8206 512.8156 240.5262  
## [8,] 252.47732 726.78141 153.8746 2689.3157 295.4063 241.9614  
## [9,] -117.02529 153.87461 466.2139 -1306.7274 -980.8325 -346.7738  
## [10,] 1671.82057 2689.31573 -1306.7274 18068.2380 5607.2306 2617.2759  
## [11,] 512.81560 295.40627 -980.8325 5607.2306 2630.5518 1055.9852  
## [12,] 240.52619 241.96140 -346.7738 2617.2759 1055.9852 445.8509  
##   
## Multivariate Tests: age\_group  
## Df test stat approx F num Df den Df Pr(>F)   
## Pillai 2 0.1718494 12.98791 24 3316 < 2.22e-16 \*\*\*  
## Wilks 2 0.8305102 13.43625 24 3314 < 2.22e-16 \*\*\*  
## Hotelling-Lawley 2 0.2012380 13.88542 24 3312 < 2.22e-16 \*\*\*  
## Roy 2 0.1859597 25.69344 12 1658 < 2.22e-16 \*\*\*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

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 2 0.61383 61.184 24 3316 < 2.2e-16 \*\*\*  
## race\_eth 4 0.46405 18.155 48 6640 < 2.2e-16 \*\*\*  
## age\_group 2 0.17185 12.988 24 3316 < 2.2e-16 \*\*\*  
## Residuals 1668   
## ---  
## 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** : Additive MANOVA Model Findings

| **term** | **df** | **pillai** | **f.statistic** | **num.df** | **den.df** | **p.value** | **signif** |
| --- | --- | --- | --- | --- | --- | --- | --- |
| gender | 2 | 0.6138304 | 61.18364 | 24 | 3,316 | 1.6560e-242 | TRUE |
| race\_eth | 4 | 0.4640521 | 18.15464 | 48 | 6,640 | 2.0755e-141 | TRUE |
| age\_group | 2 | 0.1718494 | 12.98791 | 24 | 3,316 | 2.7956e-49 | TRUE |
| Residuals | 1,668 |  |  |  |  | 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 2 15930 7965 292.470 < 2e-16 \*\*\*  
## race\_eth 4 915 229 8.398 1.05e-06 \*\*\*  
## age\_group 2 2228 1114 40.902 < 2e-16 \*\*\*  
## Residuals 1668 45426 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")  
  
  
#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** : AA\_C Additive Anova Model Findings

| **term** | **df** | **sumsq** | **meansq** | **f.statistic** | **p.value** | **signif** |
| --- | --- | --- | --- | --- | --- | --- |
| gender | 2 | 15,930.2049 | 7,965.10244 | 292.469926 | 1.3132e-109 | TRUE |
| race\_eth | 4 | 914.8536 | 228.71340 | 8.398108 | 1.0475e-06 | TRUE |
| age\_group | 2 | 2,227.8704 | 1,113.93521 | 40.902493 | 4.5513e-18 | TRUE |
| Residuals | 1,668 | 45,426.1778 | 27.23392 |  | 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 58.4 0.343 1668 57.7 59.1  
## Male 64.9 0.344 1668 64.2 65.5  
## Other 63.5 3.717 1668 56.2 70.8  
##   
## Results are averaged over the levels of: race\_eth, age\_group   
## Confidence level used: 0.95

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

| **gender** | **emmean** | **SE** | **df** | **lower.CL** | **upper.CL** |
| --- | --- | --- | --- | --- | --- |
| Female | 58.41886 | 0.3427629 | 1,668 | 57.74657 | 59.09115 |
| Male | 64.86905 | 0.3444161 | 1,668 | 64.19351 | 65.54458 |
| Other | 63.50783 | 3.7167302 | 1,668 | 56.21788 | 70.79778 |

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

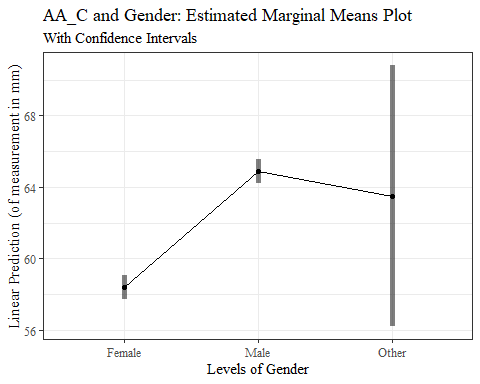
## contrast estimate SE df t.ratio p.value  
## Female - Male -6.45 0.262 1668 -24.665 <.0001  
## Female - Other -5.09 3.732 1668 -1.363 0.3605  
## Male - Other 1.36 3.734 1668 0.365 0.9294  
##   
## Results are averaged over the levels of: race\_eth, age\_group   
## P value adjustment: tukey method for comparing a family of 3 estimates

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

| **contrast** | **estimate** | **SE** | **df** | **t.ratio** | **p.value** | **signif** |
| --- | --- | --- | --- | --- | --- | --- |
| Female - Male | -6.450191 | 0.261507 | 1,668 | -24.6654603 | 1.6200e-12 | TRUE |
| Female - Other | -5.088972 | 3.732436 | 1,668 | -1.3634452 | 3.6047e-01 | FALSE |
| Male - Other | 1.361219 | 3.734316 | 1,668 | 0.3645162 | 9.2938e-01 | FALSE |

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 60.2 1.39 1668 57.5 62.9  
## Black 63.3 1.28 1668 60.8 65.8  
## LatinX 62.6 1.38 1668 59.9 65.3  
## Other 62.4 1.51 1668 59.4 65.4  
## white 62.7 1.27 1668 60.2 65.2  
##   
## Results are averaged over the levels of: gender, age\_group   
## Confidence level used: 0.95

flextable(AA\_Cr\_em1) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("Estimated Marrinal Means: AA\_C and Race/Ethnicity") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

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

| **race\_eth** | **emmean** | **SE** | **df** | **lower.CL** | **upper.CL** |
| --- | --- | --- | --- | --- | --- |
| Asian | 60.20304 | 1.388209 | 1,668 | 57.48022 | 62.92585 |
| Black | 63.34502 | 1.275600 | 1,668 | 60.84307 | 65.84696 |
| LatinX | 62.63828 | 1.381540 | 1,668 | 59.92855 | 65.34802 |
| Other | 62.40380 | 1.508201 | 1,668 | 59.44563 | 65.36196 |
| white | 62.73608 | 1.270281 | 1,668 | 60.24457 | 65.22760 |

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

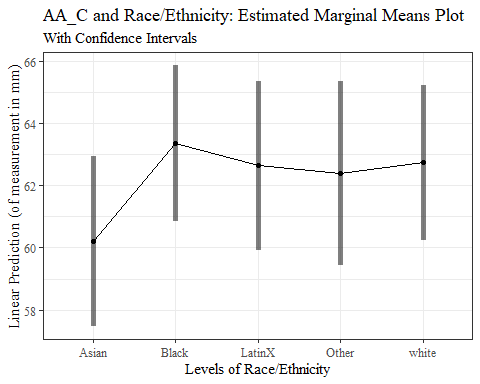
## contrast estimate SE df t.ratio p.value  
## Asian - Black -3.1420 0.633 1668 -4.962 <.0001  
## Asian - LatinX -2.4352 0.813 1668 -2.995 0.0233  
## Asian - Other -2.2008 1.188 1668 -1.852 0.3442  
## Asian - white -2.5330 0.604 1668 -4.193 0.0003  
## Black - LatinX 0.7067 0.622 1668 1.136 0.7875  
## Black - Other 0.9412 1.064 1668 0.885 0.9026  
## Black - white 0.6089 0.296 1668 2.055 0.2404  
## LatinX - Other 0.2345 1.182 1668 0.198 0.9997  
## LatinX - white -0.0978 0.593 1668 -0.165 0.9998  
## Other - white -0.3323 1.049 1668 -0.317 0.9978  
##   
## Results are averaged over the levels of: gender, age\_group   
## P value adjustment: tukey method for comparing a family of 5 estimates

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

| **contrast** | **estimate** | **SE** | **df** | **t.ratio** | **p.value** | **signif** |
| --- | --- | --- | --- | --- | --- | --- |
| Asian - Black | -3.14198047 | 0.6332545 | 1,668 | -4.9616397 | 7.6280e-06 | TRUE |
| Asian - LatinX | -2.43524818 | 0.8131135 | 1,668 | -2.9949670 | 2.3298e-02 | TRUE |
| Asian - Other | -2.20076308 | 1.1884872 | 1,668 | -1.8517348 | 3.4419e-01 | FALSE |
| Asian - white | -2.53304707 | 0.6041581 | 1,668 | -4.1926891 | 2.8027e-04 | TRUE |
| Black - LatinX | 0.70673229 | 0.6221762 | 1,668 | 1.1359037 | 7.8745e-01 | FALSE |
| Black - Other | 0.94121739 | 1.0638323 | 1,668 | 0.8847423 | 9.0260e-01 | FALSE |
| Black - white | 0.60893340 | 0.2963103 | 1,668 | 2.0550530 | 2.4040e-01 | FALSE |
| LatinX - Other | 0.23448511 | 1.1821432 | 1,668 | 0.1983559 | 9.9966e-01 | FALSE |
| LatinX - white | -0.09779889 | 0.5926523 | 1,668 | -0.1650190 | 9.9983e-01 | FALSE |
| Other - white | -0.33228399 | 1.0487881 | 1,668 | -0.3168266 | 9.9782e-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 60.5 1.25 1668 58.0 62.9  
## 37-54 62.6 1.25 1668 60.2 65.1  
## 55-72 63.7 1.38 1668 61.0 66.4  
##   
## Results are averaged over the levels of: gender, race\_eth   
## Confidence level used: 0.95

flextable(AA\_Ca\_em1) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("Estimated Marainal Means: AA\_C and Age Group") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

**Table** : Estimated Marainal Means: AA\_C and Age Group

| **age\_group** | **emmean** | **SE** | **df** | **lower.CL** | **upper.CL** |
| --- | --- | --- | --- | --- | --- |
| 18-36 | 60.45596 | 1.252148 | 1,668 | 58.00001 | 62.91190 |
| 37-54 | 62.64825 | 1.246036 | 1,668 | 60.20429 | 65.09221 |
| 55-72 | 63.69152 | 1.381461 | 1,668 | 60.98195 | 66.40110 |

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

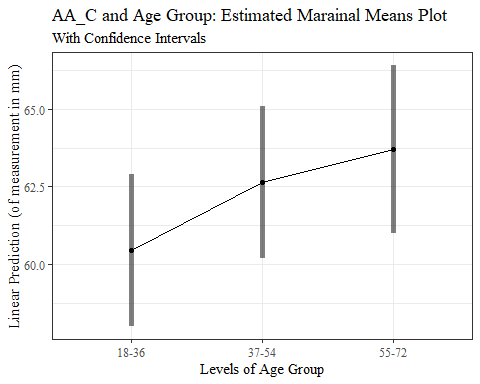
## contrast estimate SE df t.ratio p.value  
## (18-36) - (37-54) -2.19 0.263 1668 -8.337 <.0001  
## (18-36) - (55-72) -3.24 0.636 1668 -5.088 <.0001  
## (37-54) - (55-72) -1.04 0.638 1668 -1.635 0.2313  
##   
## Results are averaged over the levels of: gender, race\_eth   
## P value adjustment: tukey method for comparing a family of 3 estimates

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

| **contrast** | **estimate** | **SE** | **df** | **t.ratio** | **p.value** | **signif** |
| --- | --- | --- | --- | --- | --- | --- |
| (18-36) - (37-54) | -2.192296 | 0.2629540 | 1,668 | -8.337183 | 1.6522e-12 | TRUE |
| (18-36) - (55-72) | -3.235569 | 0.6358795 | 1,668 | -5.088337 | 1.2029e-06 | TRUE |
| (37-54) - (55-72) | -1.043273 | 0.6381668 | 1,668 | -1.634797 | 2.3128e-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 Marainal 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 2 5549 2774.7 32.781 1.09e-14 \*\*\*  
## race\_eth 4 6993 1748.3 20.654 < 2e-16 \*\*\*  
## age\_group 2 583 291.5 3.444 0.0322 \*   
## Residuals 1668 141187 84.6   
## ---  
## 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")  
  
#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** : BiW\_L Additive Anova Model Findings

| **term** | **df** | **sumsq** | **meansq** | **f.statistic** | **p.value** | **signif** |
| --- | --- | --- | --- | --- | --- | --- |
| gender | 2 | 5,549.4563 | 2,774.72815 | 32.780944 | 1.0866e-14 | TRUE |
| race\_eth | 4 | 6,993.0046 | 1,748.25116 | 20.654032 | 1.2480e-16 | TRUE |
| age\_group | 2 | 583.0936 | 291.54682 | 3.444366 | 3.2152e-02 | TRUE |
| Residuals | 1,668 | 141,187.1038 | 84.64455 |  | 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 109 0.604 1668 107.4 110  
## Male 112 0.607 1668 111.0 113  
## Other 104 6.552 1668 91.4 117  
##   
## Results are averaged over the levels of: race\_eth, age\_group   
## Confidence level used: 0.95

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

| **gender** | **emmean** | **SE** | **df** | **lower.CL** | **upper.CL** |
| --- | --- | --- | --- | --- | --- |
| Female | 108.5655 | 0.6042800 | 1,668 | 107.38025 | 109.7507 |
| Male | 112.1777 | 0.6071945 | 1,668 | 110.98673 | 113.3686 |
| Other | 104.2157 | 6.5524761 | 1,668 | 91.36379 | 117.0677 |

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

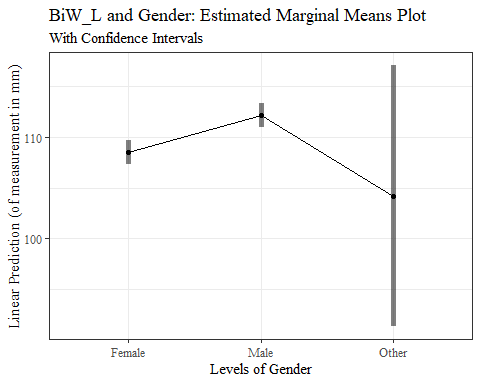
## contrast estimate SE df t.ratio p.value  
## Female - Male -3.61 0.461 1668 -7.835 <.0001  
## Female - Other 4.35 6.580 1668 0.661 0.7861  
## Male - Other 7.96 6.583 1668 1.209 0.4477  
##   
## Results are averaged over the levels of: race\_eth, age\_group   
## P value adjustment: tukey method for comparing a family of 3 estimates

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

| **contrast** | **estimate** | **SE** | **df** | **t.ratio** | **p.value** | **signif** |
| --- | --- | --- | --- | --- | --- | --- |
| Female - Male | -3.612193 | 0.4610285 | 1,668 | -7.8350748 | 1.6742e-12 | TRUE |
| Female - Other | 4.349750 | 6.5801651 | 1,668 | 0.6610396 | 7.8611e-01 | FALSE |
| Male - Other | 7.961943 | 6.5834791 | 1,668 | 1.2093822 | 4.4774e-01 | FALSE |

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 107 2.45 1668 103 112  
## Black 111 2.25 1668 107 116  
## LatinX 108 2.44 1668 103 113  
## Other 108 2.66 1668 103 113  
## white 107 2.24 1668 102 111  
##   
## Results are averaged over the levels of: gender, age\_group   
## Confidence level used: 0.95

flextable(BiW\_Lr\_em1) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("Estimated Marrinal Means: BiW\_L and Race/Ethnicity") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

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

| **race\_eth** | **emmean** | **SE** | **df** | **lower.CL** | **upper.CL** |
| --- | --- | --- | --- | --- | --- |
| Asian | 107.4177 | 2.447368 | 1,668 | 102.6174 | 112.2179 |
| Black | 111.4837 | 2.248842 | 1,668 | 107.0729 | 115.8946 |
| LatinX | 108.2642 | 2.435611 | 1,668 | 103.4871 | 113.0414 |
| Other | 107.7398 | 2.658909 | 1,668 | 102.5246 | 112.9549 |
| white | 106.6927 | 2.239464 | 1,668 | 102.3003 | 111.0852 |

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

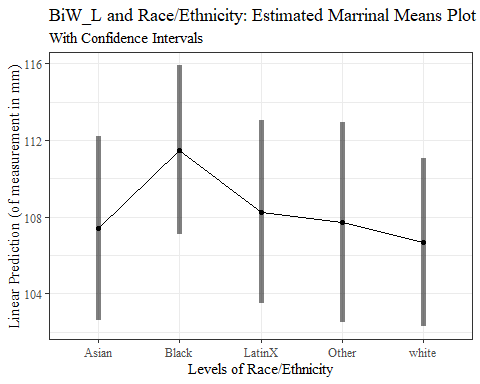
## contrast estimate SE df t.ratio p.value  
## Asian - Black -4.066 1.116 1668 -3.642 0.0026  
## Asian - LatinX -0.847 1.433 1668 -0.591 0.9765  
## Asian - Other -0.322 2.095 1668 -0.154 0.9999  
## Asian - white 0.725 1.065 1668 0.681 0.9607  
## Black - LatinX 3.220 1.097 1668 2.935 0.0279  
## Black - Other 3.744 1.876 1668 1.996 0.2682  
## Black - white 4.791 0.522 1668 9.171 <.0001  
## LatinX - Other 0.524 2.084 1668 0.252 0.9991  
## LatinX - white 1.572 1.045 1668 1.504 0.5599  
## Other - white 1.047 1.849 1668 0.566 0.9799  
##   
## Results are averaged over the levels of: gender, age\_group   
## P value adjustment: tukey method for comparing a family of 5 estimates

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

| **contrast** | **estimate** | **SE** | **df** | **t.ratio** | **p.value** | **signif** |
| --- | --- | --- | --- | --- | --- | --- |
| Asian - Black | -4.0660698 | 1.1164073 | 1,668 | -3.6421024 | 2.5804e-03 | TRUE |
| Asian - LatinX | -0.8465563 | 1.4334931 | 1,668 | -0.5905548 | 9.7651e-01 | FALSE |
| Asian - Other | -0.3221189 | 2.0952649 | 1,668 | -0.1537366 | 9.9987e-01 | FALSE |
| Asian - white | 0.7249593 | 1.0651114 | 1,668 | 0.6806418 | 9.6066e-01 | FALSE |
| Black - LatinX | 3.2195136 | 1.0968768 | 1,668 | 2.9351644 | 2.7890e-02 | TRUE |
| Black - Other | 3.7439509 | 1.8755022 | 1,668 | 1.9962392 | 2.6819e-01 | FALSE |
| Black - white | 4.7910291 | 0.5223856 | 1,668 | 9.1714419 | 1.6698e-12 | TRUE |
| LatinX - Other | 0.5244373 | 2.0840806 | 1,668 | 0.2516397 | 9.9912e-01 | FALSE |
| LatinX - white | 1.5715155 | 1.0448269 | 1,668 | 1.5040917 | 5.5992e-01 | FALSE |
| Other - white | 1.0470782 | 1.8489798 | 1,668 | 0.5663005 | 9.7989e-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 Marrinal 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  
## 18-36 109 2.21 1668 105 114  
## 37-54 109 2.20 1668 105 113  
## 55-72 107 2.44 1668 102 111  
##   
## Results are averaged over the levels of: gender, race\_eth   
## Confidence level used: 0.95

flextable(BiW\_La\_em1) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("Estimated Marainal Means: BiW\_L and Age Group") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

**Table** : Estimated Marainal Means: BiW\_L and Age Group

| **age\_group** | **emmean** | **SE** | **df** | **lower.CL** | **upper.CL** |
| --- | --- | --- | --- | --- | --- |
| 18-36 | 109.4527 | 2.207497 | 1,668 | 105.1230 | 113.7825 |
| 37-54 | 108.8118 | 2.196721 | 1,668 | 104.5031 | 113.1204 |
| 55-72 | 106.6944 | 2.435471 | 1,668 | 101.9175 | 111.4713 |

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

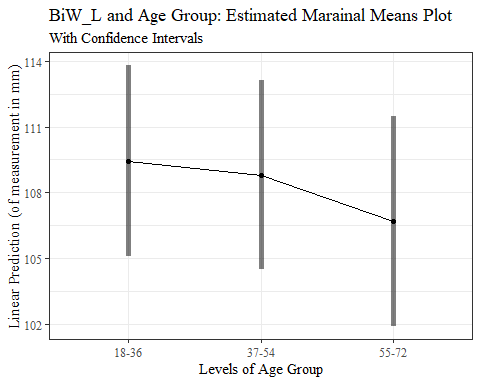
## contrast estimate SE df t.ratio p.value  
## (18-36) - (37-54) 0.641 0.464 1668 1.383 0.3502  
## (18-36) - (55-72) 2.758 1.121 1668 2.461 0.0372  
## (37-54) - (55-72) 2.117 1.125 1668 1.882 0.1442  
##   
## Results are averaged over the levels of: gender, race\_eth   
## P value adjustment: tukey method for comparing a family of 3 estimates

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

| **contrast** | **estimate** | **SE** | **df** | **t.ratio** | **p.value** | **signif** |
| --- | --- | --- | --- | --- | --- | --- |
| (18-36) - (37-54) | 0.6409839 | 0.4635795 | 1,668 | 1.382684 | 3.5021e-01 | FALSE |
| (18-36) - (55-72) | 2.7583646 | 1.1210351 | 1,668 | 2.460551 | 3.7175e-02 | TRUE |
| (37-54) - (55-72) | 2.1173806 | 1.1250676 | 1,668 | 1.882003 | 1.4420e-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 Marainal 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 2 29718 14859 104.986 < 2e-16 \*\*\*  
## race\_eth 4 3057 764 5.400 0.000255 \*\*\*  
## age\_group 2 467 233 1.649 0.192617   
## Residuals 1668 236075 142   
## ---  
## 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")  
  
#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** : BiW\_C Additive Anova Model Findings

| **term** | **df** | **sumsq** | **meansq** | **f.statistic** | **p.value** | **signif** |
| --- | --- | --- | --- | --- | --- | --- |
| gender | 2 | 29,717.6988 | 14,858.8494 | 104.985760 | 1.1347e-43 | TRUE |
| race\_eth | 4 | 3,057.1604 | 764.2901 | 5.400120 | 2.5492e-04 | TRUE |
| age\_group | 2 | 466.6811 | 233.3406 | 1.648677 | 1.9262e-01 | FALSE |
| Residuals | 1,668 | 236,075.4519 | 141.5320 |  | 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 127 0.781 1668 126 129  
## Male 136 0.785 1668 134 137  
## Other 126 8.473 1668 109 143  
##   
## Results are averaged over the levels of: race\_eth, age\_group   
## Confidence level used: 0.95

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

| **gender** | **emmean** | **SE** | **df** | **lower.CL** | **upper.CL** |
| --- | --- | --- | --- | --- | --- |
| Female | 127.1784 | 0.7813869 | 1,668 | 125.6458 | 128.7110 |
| Male | 135.9413 | 0.7851555 | 1,668 | 134.4013 | 137.4813 |
| Other | 125.9214 | 8.4729247 | 1,668 | 109.3027 | 142.5401 |

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

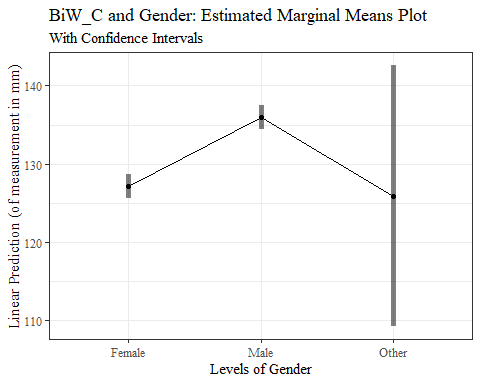
## contrast estimate SE df t.ratio p.value  
## Female - Male -8.76 0.596 1668 -14.699 <.0001  
## Female - Other 1.26 8.509 1668 0.148 0.9880  
## Male - Other 10.02 8.513 1668 1.177 0.4671  
##   
## Results are averaged over the levels of: race\_eth, age\_group   
## P value adjustment: tukey method for comparing a family of 3 estimates

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

| **contrast** | **estimate** | **SE** | **df** | **t.ratio** | **p.value** | **signif** |
| --- | --- | --- | --- | --- | --- | --- |
| Female - Male | -8.762905 | 0.5961501 | 1,668 | -14.6991570 | 1.6200e-12 | TRUE |
| Female - Other | 1.256993 | 8.5087290 | 1,668 | 0.1477299 | 9.8804e-01 | FALSE |
| Male - Other | 10.019898 | 8.5130143 | 1,668 | 1.1770094 | 4.6709e-01 | FALSE |

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 125 3.16 1668 119 131  
## Black 132 2.91 1668 126 138  
## LatinX 131 3.15 1668 125 137  
## Other 130 3.44 1668 123 137  
## white 131 2.90 1668 125 136  
##   
## Results are averaged over the levels of: gender, age\_group   
## Confidence level used: 0.95

flextable(BiW\_Cr\_em1) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("Estimated Marrinal Means: BiW\_C and Race/Ethnicity") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

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

| **race\_eth** | **emmean** | **SE** | **df** | **lower.CL** | **upper.CL** |
| --- | --- | --- | --- | --- | --- |
| Asian | 125.2018 | 3.164660 | 1,668 | 118.9947 | 131.4089 |
| Black | 131.8942 | 2.907950 | 1,668 | 126.1906 | 137.5979 |
| LatinX | 130.8370 | 3.149458 | 1,668 | 124.6597 | 137.0143 |
| Other | 129.9276 | 3.438203 | 1,668 | 123.1840 | 136.6713 |
| white | 130.5411 | 2.895823 | 1,668 | 124.8613 | 136.2210 |

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

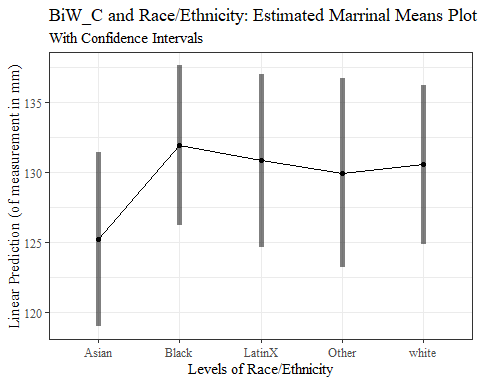
## contrast estimate SE df t.ratio p.value  
## Asian - Black -6.692 1.444 1668 -4.636 <.0001  
## Asian - LatinX -5.635 1.854 1668 -3.040 0.0203  
## Asian - Other -4.726 2.709 1668 -1.744 0.4070  
## Asian - white -5.339 1.377 1668 -3.877 0.0010  
## Black - LatinX 1.057 1.418 1668 0.745 0.9457  
## Black - Other 1.967 2.425 1668 0.811 0.9273  
## Black - white 1.353 0.675 1668 2.003 0.2648  
## LatinX - Other 0.909 2.695 1668 0.337 0.9972  
## LatinX - white 0.296 1.351 1668 0.219 0.9995  
## Other - white -0.614 2.391 1668 -0.257 0.9990  
##   
## Results are averaged over the levels of: gender, age\_group   
## P value adjustment: tukey method for comparing a family of 5 estimates

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

| **contrast** | **estimate** | **SE** | **df** | **t.ratio** | **p.value** | **signif** |
| --- | --- | --- | --- | --- | --- | --- |
| Asian - Black | -6.6924157 | 1.4436123 | 1,668 | -4.6358816 | 3.7659e-05 | TRUE |
| Asian - LatinX | -5.6351454 | 1.8536319 | 1,668 | -3.0400563 | 2.0288e-02 | TRUE |
| Asian - Other | -4.7257829 | 2.7093607 | 1,668 | -1.7442428 | 4.0703e-01 | FALSE |
| Asian - white | -5.3392992 | 1.3772822 | 1,668 | -3.8766924 | 1.0408e-03 | TRUE |
| Black - LatinX | 1.0572703 | 1.4183576 | 1,668 | 0.7454187 | 9.4571e-01 | FALSE |
| Black - Other | 1.9666328 | 2.4251884 | 1,668 | 0.8109196 | 9.2734e-01 | FALSE |
| Black - white | 1.3531165 | 0.6754903 | 1,668 | 2.0031621 | 2.6482e-01 | FALSE |
| LatinX - Other | 0.9093625 | 2.6948984 | 1,668 | 0.3374385 | 9.9721e-01 | FALSE |
| LatinX - white | 0.2958462 | 1.3510526 | 1,668 | 0.2189746 | 9.9949e-01 | FALSE |
| Other - white | -0.6135163 | 2.3908926 | 1,668 | -0.2566055 | 9.9905e-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 Marrinal 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 2 49207 24603 151.47 < 2e-16 \*\*\*  
## race\_eth 4 10265 2566 15.80 1.07e-12 \*\*\*  
## age\_group 2 26107 13054 80.36 < 2e-16 \*\*\*  
## Residuals 1668 270930 162   
## ---  
## 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")  
  
#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** : GoSub\_C Additive Anova Model Findings

| **term** | **df** | **sumsq** | **meansq** | **f.statistic** | **p.value** | **signif** |
| --- | --- | --- | --- | --- | --- | --- |
| gender | 2 | 49,206.92 | 24,603.4590 | 151.47277 | 3.5716e-61 | TRUE |
| race\_eth | 4 | 10,265.48 | 2,566.3711 | 15.80003 | 1.0652e-12 | TRUE |
| age\_group | 2 | 26,107.19 | 13,053.5965 | 80.36530 | 4.7712e-34 | TRUE |
| Residuals | 1,668 | 270,930.35 | 162.4283 |  | 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 93.7 0.837 1668 92.1 95.4  
## Male 105.1 0.841 1668 103.5 106.8  
## Other 116.8 9.077 1668 99.0 134.6  
##   
## Results are averaged over the levels of: race\_eth, age\_group   
## Confidence level used: 0.95

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

| **gender** | **emmean** | **SE** | **df** | **lower.CL** | **upper.CL** |
| --- | --- | --- | --- | --- | --- |
| Female | 93.73949 | 0.8370850 | 1,668 | 92.09764 | 95.38134 |
| Male | 105.12680 | 0.8411222 | 1,668 | 103.47703 | 106.77657 |
| Other | 116.80087 | 9.0768835 | 1,668 | 98.99759 | 134.60415 |

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

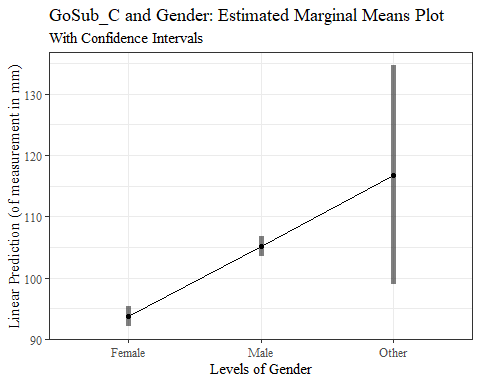
## contrast estimate SE df t.ratio p.value  
## Female - Male -11.4 0.639 1668 -17.830 <.0001  
## Female - Other -23.1 9.115 1668 -2.530 0.0309  
## Male - Other -11.7 9.120 1668 -1.280 0.4066  
##   
## Results are averaged over the levels of: race\_eth, age\_group   
## P value adjustment: tukey method for comparing a family of 3 estimates

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

| **contrast** | **estimate** | **SE** | **df** | **t.ratio** | **p.value** | **signif** |
| --- | --- | --- | --- | --- | --- | --- |
| Female - Male | -11.38731 | 0.6386443 | 1,668 | -17.830440 | 1.6200e-12 | TRUE |
| Female - Other | -23.06138 | 9.1152400 | 1,668 | -2.529981 | 3.0869e-02 | TRUE |
| Male - Other | -11.67407 | 9.1198307 | 1,668 | -1.280075 | 4.0663e-01 | FALSE |

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 103 3.39 1668 96.8 110  
## Black 110 3.12 1668 103.9 116  
## LatinX 106 3.37 1668 98.9 112  
## Other 101 3.68 1668 94.2 109  
## white 106 3.10 1668 99.6 112  
##   
## Results are averaged over the levels of: gender, age\_group   
## Confidence level used: 0.95

flextable(GoSub\_Cr\_em1) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("Estimated Marrinal Means: GoSub\_C and Race/Ethnicity") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

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

| **race\_eth** | **emmean** | **SE** | **df** | **lower.CL** | **upper.CL** |
| --- | --- | --- | --- | --- | --- |
| Asian | 103.4327 | 3.390241 | 1,668 | 96.78313 | 110.0823 |
| Black | 110.0392 | 3.115231 | 1,668 | 103.92900 | 116.1494 |
| LatinX | 105.5345 | 3.373954 | 1,668 | 98.91684 | 112.1521 |
| Other | 101.4115 | 3.683281 | 1,668 | 94.18713 | 108.6358 |
| white | 105.6941 | 3.102240 | 1,668 | 99.60943 | 111.7788 |

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

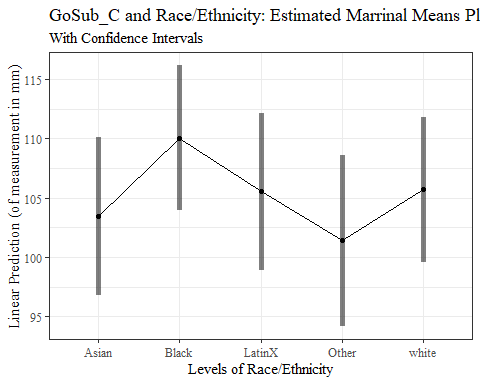
## contrast estimate SE df t.ratio p.value  
## Asian - Black -6.61 1.547 1668 -4.272 0.0002  
## Asian - LatinX -2.10 1.986 1668 -1.058 0.8277  
## Asian - Other 2.02 2.902 1668 0.696 0.9573  
## Asian - white -2.26 1.475 1668 -1.533 0.5412  
## Black - LatinX 4.50 1.519 1668 2.965 0.0255  
## Black - Other 8.63 2.598 1668 3.321 0.0081  
## Black - white 4.35 0.724 1668 6.004 <.0001  
## LatinX - Other 4.12 2.887 1668 1.428 0.6095  
## LatinX - white -0.16 1.447 1668 -0.110 1.0000  
## Other - white -4.28 2.561 1668 -1.672 0.4516  
##   
## Results are averaged over the levels of: gender, age\_group   
## P value adjustment: tukey method for comparing a family of 5 estimates

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

| **contrast** | **estimate** | **SE** | **df** | **t.ratio** | **p.value** | **signif** |
| --- | --- | --- | --- | --- | --- | --- |
| Asian - Black | -6.6064705 | 1.5465145 | 1,668 | -4.2718452 | 1.9863e-04 | TRUE |
| Asian - LatinX | -2.1017606 | 1.9857607 | 1,668 | -1.0584158 | 8.2774e-01 | FALSE |
| Asian - Other | 2.0212375 | 2.9024867 | 1,668 | 0.6963813 | 9.5731e-01 | FALSE |
| Asian - white | -2.2614177 | 1.4754562 | 1,668 | -1.5326904 | 5.4124e-01 | FALSE |
| Black - LatinX | 4.5047099 | 1.5194596 | 1,668 | 2.9646790 | 2.5533e-02 | TRUE |
| Black - Other | 8.6277080 | 2.5980583 | 1,668 | 3.3208293 | 8.1450e-03 | TRUE |
| Black - white | 4.3450528 | 0.7236399 | 1,668 | 6.0044406 | 2.3481e-08 | TRUE |
| LatinX - Other | 4.1229981 | 2.8869936 | 1,668 | 1.4281286 | 6.0951e-01 | FALSE |
| LatinX - white | -0.1596571 | 1.4473570 | 1,668 | -0.1103094 | 9.9997e-01 | FALSE |
| Other - white | -4.2826552 | 2.5613179 | 1,668 | -1.6720514 | 4.5163e-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 Marrinal 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 99.3 3.06 1668 93.3 105  
## 37-54 106.9 3.04 1668 101.0 113  
## 55-72 109.5 3.37 1668 102.9 116  
##   
## Results are averaged over the levels of: gender, race\_eth   
## Confidence level used: 0.95

flextable(GoSub\_Ca\_em1) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("Estimated Marainal Means: GoSub\_C and Age Group") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

**Table** : Estimated Marainal Means: GoSub\_C and Age Group

| **age\_group** | **emmean** | **SE** | **df** | **lower.CL** | **upper.CL** |
| --- | --- | --- | --- | --- | --- |
| 18-36 | 99.26163 | 3.057957 | 1,668 | 93.26379 | 105.2595 |
| 37-54 | 106.91858 | 3.043030 | 1,668 | 100.95002 | 112.8871 |
| 55-72 | 109.48695 | 3.373761 | 1,668 | 102.86970 | 116.1042 |

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

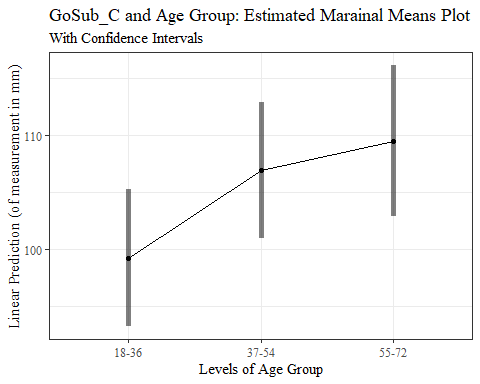
## contrast estimate SE df t.ratio p.value  
## (18-36) - (37-54) -7.66 0.642 1668 -11.923 <.0001  
## (18-36) - (55-72) -10.23 1.553 1668 -6.585 <.0001  
## (37-54) - (55-72) -2.57 1.559 1668 -1.648 0.2259  
##   
## Results are averaged over the levels of: gender, race\_eth   
## P value adjustment: tukey method for comparing a family of 3 estimates

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

| **contrast** | **estimate** | **SE** | **df** | **t.ratio** | **p.value** | **signif** |
| --- | --- | --- | --- | --- | --- | --- |
| (18-36) - (37-54) | -7.656954 | 0.6421782 | 1,668 | -11.923410 | 1.6200e-12 | TRUE |
| (18-36) - (55-72) | -10.225324 | 1.5529252 | 1,668 | -6.584556 | 1.8448e-10 | TRUE |
| (37-54) - (55-72) | -2.568370 | 1.5585112 | 1,668 | -1.647964 | 2.2590e-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 Marainal 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 2 182 91.2 4.398 0.0124 \*   
## race\_eth 4 1889 472.2 22.763 <2e-16 \*\*\*  
## age\_group 2 88 43.8 2.111 0.1215   
## Residuals 1668 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")  
  
#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** : NRB\_L Additive Anova Model Findings

| **term** | **df** | **sumsq** | **meansq** | **f.statistic** | **p.value** | **signif** |
| --- | --- | --- | --- | --- | --- | --- |
| gender | 2 | 182.48528 | 91.24264 | 4.398047 | 1.2444e-02 | TRUE |
| race\_eth | 4 | 1,888.96682 | 472.24170 | 22.762833 | 2.4794e-18 | TRUE |
| age\_group | 2 | 87.58197 | 43.79098 | 2.110798 | 1.2146e-01 | FALSE |
| Residuals | 1,668 | 34,604.61889 | 20.74617 |  | 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 18.2 0.299 1668 17.6 18.8  
## Male 17.5 0.301 1668 16.9 18.1  
## Other 17.8 3.244 1668 11.4 24.1  
##   
## Results are averaged over the levels of: race\_eth, age\_group   
## Confidence level used: 0.95

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

| **gender** | **emmean** | **SE** | **df** | **lower.CL** | **upper.CL** |
| --- | --- | --- | --- | --- | --- |
| Female | 18.21242 | 0.2991629 | 1,668 | 17.62564 | 18.79919 |
| Male | 17.49554 | 0.3006058 | 1,668 | 16.90594 | 18.08515 |
| Other | 17.76856 | 3.2439561 | 1,668 | 11.40591 | 24.13122 |

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

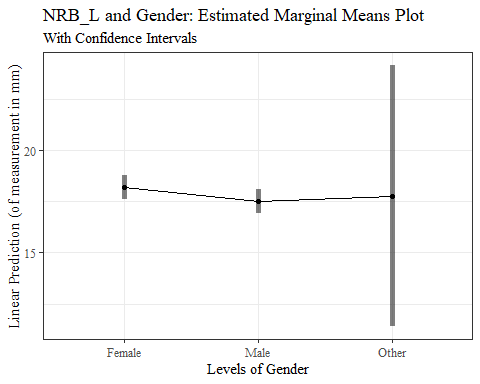
## contrast estimate SE df t.ratio p.value  
## Female - Male 0.717 0.228 1668 3.141 0.0049  
## Female - Other 0.444 3.258 1668 0.136 0.9898  
## Male - Other -0.273 3.259 1668 -0.084 0.9961  
##   
## Results are averaged over the levels of: race\_eth, age\_group   
## P value adjustment: tukey method for comparing a family of 3 estimates

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

| **contrast** | **estimate** | **SE** | **df** | **t.ratio** | **p.value** | **signif** |
| --- | --- | --- | --- | --- | --- | --- |
| Female - Male | 0.7168729 | 0.2282429 | 1,668 | 3.14083334 | 4.8769e-03 | TRUE |
| Female - Other | 0.4438538 | 3.2576642 | 1,668 | 0.13624911 | 9.8982e-01 | FALSE |
| Male - Other | -0.2730191 | 3.2593049 | 1,668 | -0.08376604 | 9.9614e-01 | FALSE |

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 1.21 1668 14.3 19.0  
## Black 19.3 1.11 1668 17.2 21.5  
## LatinX 17.4 1.21 1668 15.0 19.7  
## Other 18.8 1.32 1668 16.2 21.4  
## white 16.9 1.11 1668 14.7 19.1  
##   
## Results are averaged over the levels of: gender, age\_group   
## Confidence level used: 0.95

flextable(NRB\_Lr\_em1) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("Estimated Marrinal Means: NRB\_L and Race/Ethnicity") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

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

| **race\_eth** | **emmean** | **SE** | **df** | **lower.CL** | **upper.CL** |
| --- | --- | --- | --- | --- | --- |
| Asian | 16.66917 | 1.211626 | 1,668 | 14.29270 | 19.04564 |
| Black | 19.34635 | 1.113342 | 1,668 | 17.16265 | 21.53004 |
| LatinX | 17.36930 | 1.205806 | 1,668 | 15.00424 | 19.73435 |
| Other | 18.82745 | 1.316355 | 1,668 | 16.24557 | 21.40933 |
| white | 16.91528 | 1.108699 | 1,668 | 14.74069 | 19.08986 |

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

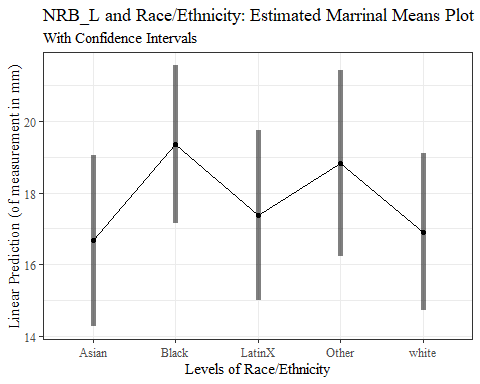
## contrast estimate SE df t.ratio p.value  
## Asian - Black -2.677 0.553 1668 -4.844 <.0001  
## Asian - LatinX -0.700 0.710 1668 -0.987 0.8615  
## Asian - Other -2.158 1.037 1668 -2.081 0.2289  
## Asian - white -0.246 0.527 1668 -0.467 0.9903  
## Black - LatinX 1.977 0.543 1668 3.641 0.0026  
## Black - Other 0.519 0.929 1668 0.559 0.9809  
## Black - white 2.431 0.259 1668 9.400 <.0001  
## LatinX - Other -1.458 1.032 1668 -1.413 0.6192  
## LatinX - white 0.454 0.517 1668 0.878 0.9051  
## Other - white 1.912 0.915 1668 2.089 0.2253  
##   
## Results are averaged over the levels of: gender, age\_group   
## P value adjustment: tukey method for comparing a family of 5 estimates

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

| **contrast** | **estimate** | **SE** | **df** | **t.ratio** | **p.value** | **signif** |
| --- | --- | --- | --- | --- | --- | --- |
| Asian - Black | -2.6771734 | 0.5527035 | 1,668 | -4.8437788 | 1.3753e-05 | TRUE |
| Asian - LatinX | -0.7001225 | 0.7096842 | 1,668 | -0.9865268 | 8.6147e-01 | FALSE |
| Asian - Other | -2.1582778 | 1.0373097 | 1,668 | -2.0806493 | 2.2891e-01 | FALSE |
| Asian - white | -0.2461037 | 0.5273082 | 1,668 | -0.4667170 | 9.9027e-01 | FALSE |
| Black - LatinX | 1.9770509 | 0.5430344 | 1,668 | 3.6407470 | 2.5935e-03 | TRUE |
| Black - Other | 0.5188956 | 0.9285111 | 1,668 | 0.5588469 | 9.8085e-01 | FALSE |
| Black - white | 2.4310697 | 0.2586192 | 1,668 | 9.4001914 | 1.6682e-12 | TRUE |
| LatinX - Other | -1.4581553 | 1.0317727 | 1,668 | -1.4132525 | 6.1917e-01 | FALSE |
| LatinX - white | 0.4540188 | 0.5172659 | 1,668 | 0.8777280 | 9.0514e-01 | FALSE |
| Other - white | 1.9121741 | 0.9153806 | 1,668 | 2.0889389 | 2.2526e-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 Marrinal 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 2 428 214.13 38.61 < 2e-16 \*\*\*  
## race\_eth 4 998 249.58 45.00 < 2e-16 \*\*\*  
## age\_group 2 374 186.94 33.71 4.46e-15 \*\*\*  
## Residuals 1668 9251 5.55   
## ---  
## 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")  
  
#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** : ProS\_L Additive Anova Model Findings

| **term** | **df** | **sumsq** | **meansq** | **f.statistic** | **p.value** | **signif** |
| --- | --- | --- | --- | --- | --- | --- |
| gender | 2 | 428.2661 | 214.133034 | 38.61075 | 4.0564e-17 | TRUE |
| race\_eth | 4 | 998.3279 | 249.581979 | 45.00262 | 6.2385e-36 | TRUE |
| age\_group | 2 | 373.8867 | 186.943341 | 33.70812 | 4.4550e-15 | TRUE |
| Residuals | 1,668 | 9,250.6332 | 5.545943 |  | 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 18.1 0.155 1668 17.8 18.4  
## Male 19.3 0.155 1668 19.0 19.6  
## Other 17.8 1.677 1668 14.5 21.1  
##   
## Results are averaged over the levels of: race\_eth, age\_group   
## Confidence level used: 0.95

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

| **gender** | **emmean** | **SE** | **df** | **lower.CL** | **upper.CL** |
| --- | --- | --- | --- | --- | --- |
| Female | 18.09923 | 0.1546772 | 1,668 | 17.79585 | 18.40261 |
| Male | 19.26452 | 0.1554233 | 1,668 | 18.95967 | 19.56936 |
| Other | 17.78940 | 1.6772340 | 1,668 | 14.49970 | 21.07911 |

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

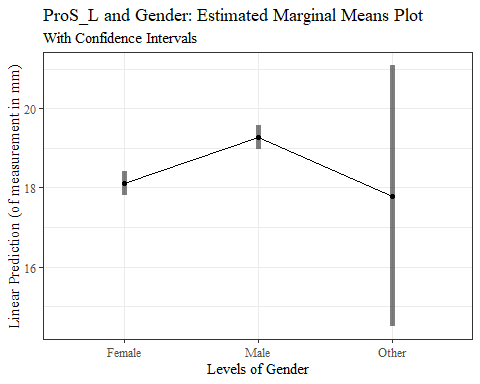
## contrast estimate SE df t.ratio p.value  
## Female - Male -1.17 0.118 1668 -9.875 <.0001  
## Female - Other 0.31 1.684 1668 0.184 0.9815  
## Male - Other 1.48 1.685 1668 0.875 0.6560  
##   
## Results are averaged over the levels of: race\_eth, age\_group   
## P value adjustment: tukey method for comparing a family of 3 estimates

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

| **contrast** | **estimate** | **SE** | **df** | **t.ratio** | **p.value** | **signif** |
| --- | --- | --- | --- | --- | --- | --- |
| Female - Male | -1.1652886 | 0.1180092 | 1,668 | -9.8745549 | 1.6480e-12 | TRUE |
| Female - Other | 0.3098252 | 1.6843216 | 1,668 | 0.1839466 | 9.8152e-01 | FALSE |
| Male - Other | 1.4751138 | 1.6851698 | 1,668 | 0.8753502 | 6.5595e-01 | FALSE |

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 18.0 0.626 1668 16.8 19.3  
## Black 18.0 0.576 1668 16.9 19.1  
## LatinX 18.6 0.623 1668 17.4 19.8  
## Other 17.6 0.681 1668 16.3 18.9  
## white 19.7 0.573 1668 18.6 20.8  
##   
## Results are averaged over the levels of: gender, age\_group   
## Confidence level used: 0.95

flextable(ProS\_Lr\_em1) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("Estimated Marrinal Means: ProS\_L and Race/Ethnicity") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

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

| **race\_eth** | **emmean** | **SE** | **df** | **lower.CL** | **upper.CL** |
| --- | --- | --- | --- | --- | --- |
| Asian | 18.03854 | 0.6264514 | 1,668 | 16.80982 | 19.26725 |
| Black | 18.01596 | 0.5756350 | 1,668 | 16.88691 | 19.14500 |
| LatinX | 18.59408 | 0.6234420 | 1,668 | 17.37127 | 19.81689 |
| Other | 17.58638 | 0.6805997 | 1,668 | 16.25146 | 18.92130 |
| white | 19.68696 | 0.5732345 | 1,668 | 18.56263 | 20.81130 |

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

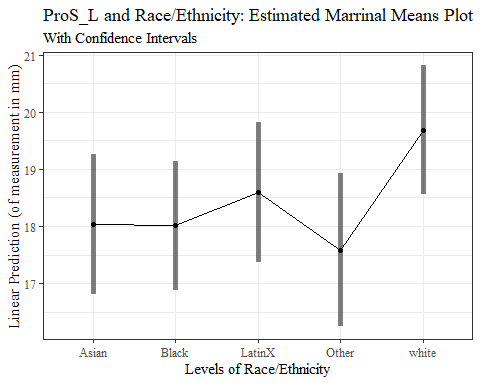
## contrast estimate SE df t.ratio p.value  
## Asian - Black 0.0226 0.286 1668 0.079 1.0000  
## Asian - LatinX -0.5555 0.367 1668 -1.514 0.5534  
## Asian - Other 0.4522 0.536 1668 0.843 0.9171  
## Asian - white -1.6484 0.273 1668 -6.046 <.0001  
## Black - LatinX -0.5781 0.281 1668 -2.059 0.2386  
## Black - Other 0.4296 0.480 1668 0.895 0.8989  
## Black - white -1.6710 0.134 1668 -12.497 <.0001  
## LatinX - Other 1.0077 0.533 1668 1.889 0.3236  
## LatinX - white -1.0929 0.267 1668 -4.086 0.0004  
## Other - white -2.1006 0.473 1668 -4.438 0.0001  
##   
## Results are averaged over the levels of: gender, age\_group   
## P value adjustment: tukey method for comparing a family of 5 estimates

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

| **contrast** | **estimate** | **SE** | **df** | **t.ratio** | **p.value** | **signif** |
| --- | --- | --- | --- | --- | --- | --- |
| Asian - Black | 0.02258037 | 0.2857662 | 1,668 | 0.07901694 | 9.9999e-01 | FALSE |
| Asian - LatinX | -0.55554156 | 0.3669305 | 1,668 | -1.51402392 | 5.5343e-01 | FALSE |
| Asian - Other | 0.45215371 | 0.5363239 | 1,668 | 0.84306090 | 9.1710e-01 | FALSE |
| Asian - white | -1.64842752 | 0.2726360 | 1,668 | -6.04625724 | 1.8234e-08 | TRUE |
| Black - LatinX | -0.57812194 | 0.2807670 | 1,668 | -2.05908085 | 2.3857e-01 | FALSE |
| Black - Other | 0.42957333 | 0.4800714 | 1,668 | 0.89481143 | 8.9889e-01 | FALSE |
| Black - white | -1.67100789 | 0.1337148 | 1,668 | -12.49680794 | 1.6200e-12 | TRUE |
| LatinX - Other | 1.00769527 | 0.5334611 | 1,668 | 1.88897626 | 3.2361e-01 | FALSE |
| LatinX - white | -1.09288595 | 0.2674438 | 1,668 | -4.08641310 | 4.4064e-04 | TRUE |
| Other - white | -2.10058122 | 0.4732824 | 1,668 | -4.43832488 | 9.4355e-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 Marrinal 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 17.7 0.565 1668 16.6 18.8  
## 37-54 18.7 0.562 1668 17.6 19.8  
## 55-72 18.7 0.623 1668 17.5 20.0  
##   
## Results are averaged over the levels of: gender, race\_eth   
## Confidence level used: 0.95

flextable(ProS\_La\_em1) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("Estimated Marainal Means: ProS\_L and Age Group") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

**Table** : Estimated Marainal Means: ProS\_L and Age Group

| **age\_group** | **emmean** | **SE** | **df** | **lower.CL** | **upper.CL** |
| --- | --- | --- | --- | --- | --- |
| 18-36 | 17.73263 | 0.5650518 | 1,668 | 16.62435 | 18.84092 |
| 37-54 | 18.67819 | 0.5622936 | 1,668 | 17.57532 | 19.78107 |
| 55-72 | 18.74232 | 0.6234063 | 1,668 | 17.51958 | 19.96506 |

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

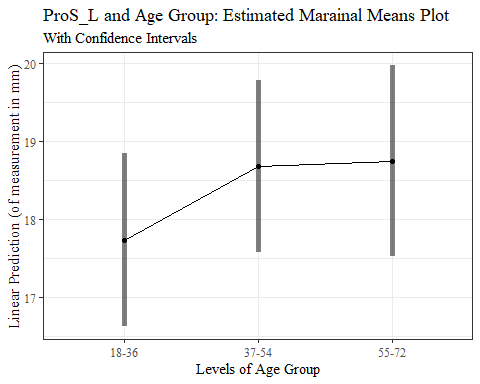
## contrast estimate SE df t.ratio p.value  
## (18-36) - (37-54) -0.9456 0.119 1668 -7.968 <.0001  
## (18-36) - (55-72) -1.0097 0.287 1668 -3.519 0.0013  
## (37-54) - (55-72) -0.0641 0.288 1668 -0.223 0.9730  
##   
## Results are averaged over the levels of: gender, race\_eth   
## P value adjustment: tukey method for comparing a family of 3 estimates

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

| **contrast** | **estimate** | **SE** | **df** | **t.ratio** | **p.value** | **signif** |
| --- | --- | --- | --- | --- | --- | --- |
| (18-36) - (37-54) | -0.9455593 | 0.1186622 | 1,668 | -7.9684946 | 1.6660e-12 | TRUE |
| (18-36) - (55-72) | -1.0096876 | 0.2869508 | 1,668 | -3.5186783 | 1.2938e-03 | TRUE |
| (37-54) - (55-72) | -0.0641283 | 0.2879830 | 1,668 | -0.2226809 | 9.7303e-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 Marainal 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 2 5228 2613.9 180.701 < 2e-16 \*\*\*  
## race\_eth 4 1260 315.1 21.784 < 2e-16 \*\*\*  
## age\_group 2 155 77.4 5.348 0.00484 \*\*   
## Residuals 1668 24128 14.5   
## ---  
## 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")  
  
#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** : SelP\_L Additive Anova Model Findings

| **term** | **df** | **sumsq** | **meansq** | **f.statistic** | **p.value** | **signif** |
| --- | --- | --- | --- | --- | --- | --- |
| gender | 2 | 5,227.766 | 2,613.88305 | 180.701295 | 9.2558e-72 | TRUE |
| race\_eth | 4 | 1,260.452 | 315.11309 | 21.784197 | 1.5261e-17 | TRUE |
| age\_group | 2 | 154.731 | 77.36552 | 5.348384 | 4.8377e-03 | TRUE |
| Residuals | 1,668 | 24,127.978 | 14.46521 |  | 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 42.8 0.250 1668 42.3 43.3  
## Male 46.5 0.251 1668 46.0 47.0  
## Other 38.0 2.709 1668 32.7 43.3  
##   
## Results are averaged over the levels of: race\_eth, age\_group   
## Confidence level used: 0.95

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

| **gender** | **emmean** | **SE** | **df** | **lower.CL** | **upper.CL** |
| --- | --- | --- | --- | --- | --- |
| Female | 42.82944 | 0.2498050 | 1,668 | 42.33947 | 43.31940 |
| Male | 46.50229 | 0.2510098 | 1,668 | 46.00996 | 46.99462 |
| Other | 37.98694 | 2.7087467 | 1,668 | 32.67404 | 43.29984 |

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

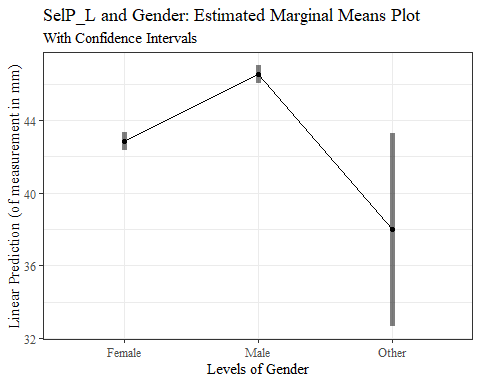
## contrast estimate SE df t.ratio p.value  
## Female - Male -3.67 0.191 1668 -19.271 <.0001  
## Female - Other 4.84 2.720 1668 1.780 0.1765  
## Male - Other 8.52 2.722 1668 3.129 0.0051  
##   
## Results are averaged over the levels of: race\_eth, age\_group   
## P value adjustment: tukey method for comparing a family of 3 estimates

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

| **contrast** | **estimate** | **SE** | **df** | **t.ratio** | **p.value** | **signif** |
| --- | --- | --- | --- | --- | --- | --- |
| Female - Male | -3.672848 | 0.1905859 | 1,668 | -19.271356 | 1.6200e-12 | TRUE |
| Female - Other | 4.842500 | 2.7201932 | 1,668 | 1.780205 | 1.7654e-01 | FALSE |
| Male - Other | 8.515349 | 2.7215632 | 1,668 | 3.128845 | 5.0749e-03 | 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 41.4 1.012 1668 39.4 43.4  
## Black 41.3 0.930 1668 39.4 43.1  
## LatinX 43.0 1.007 1668 41.0 45.0  
## Other 43.3 1.099 1668 41.2 45.5  
## white 43.2 0.926 1668 41.4 45.0  
##   
## Results are averaged over the levels of: gender, age\_group   
## Confidence level used: 0.95

flextable(SelP\_Lr\_em1) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("Estimated Marrinal Means: SelP\_L and Race/Ethnicity") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

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

| **race\_eth** | **emmean** | **SE** | **df** | **lower.CL** | **upper.CL** |
| --- | --- | --- | --- | --- | --- |
| Asian | 41.42169 | 1.0117242 | 1,668 | 39.43730 | 43.40607 |
| Black | 41.25380 | 0.9296553 | 1,668 | 39.43038 | 43.07721 |
| LatinX | 43.00516 | 1.0068640 | 1,668 | 41.03031 | 44.98001 |
| Other | 43.33003 | 1.0991741 | 1,668 | 41.17413 | 45.48594 |
| white | 43.18710 | 0.9257784 | 1,668 | 41.37129 | 45.00291 |

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

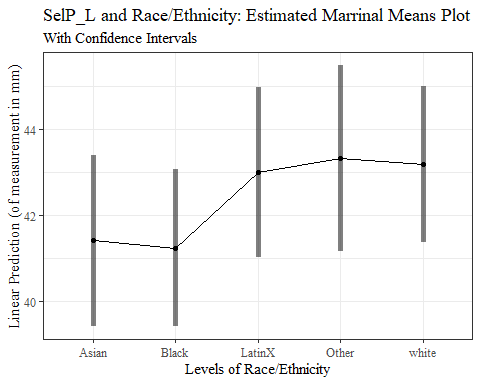
## contrast estimate SE df t.ratio p.value  
## Asian - Black 0.168 0.462 1668 0.364 0.9963  
## Asian - LatinX -1.583 0.593 1668 -2.672 0.0586  
## Asian - Other -1.908 0.866 1668 -2.203 0.1789  
## Asian - white -1.765 0.440 1668 -4.009 0.0006  
## Black - LatinX -1.751 0.453 1668 -3.862 0.0011  
## Black - Other -2.076 0.775 1668 -2.678 0.0577  
## Black - white -1.933 0.216 1668 -8.953 <.0001  
## LatinX - Other -0.325 0.862 1668 -0.377 0.9957  
## LatinX - white -0.182 0.432 1668 -0.421 0.9934  
## Other - white 0.143 0.764 1668 0.187 0.9997  
##   
## Results are averaged over the levels of: gender, age\_group   
## P value adjustment: tukey method for comparing a family of 5 estimates

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

| **contrast** | **estimate** | **SE** | **df** | **t.ratio** | **p.value** | **signif** |
| --- | --- | --- | --- | --- | --- | --- |
| Asian - Black | 0.1678881 | 0.4615148 | 1,668 | 0.3637761 | 9.9627e-01 | FALSE |
| Asian - LatinX | -1.5834765 | 0.5925958 | 1,668 | -2.6721023 | 5.8586e-02 | FALSE |
| Asian - Other | -1.9083450 | 0.8661675 | 1,668 | -2.2032056 | 1.7892e-01 | FALSE |
| Asian - white | -1.7654092 | 0.4403094 | 1,668 | -4.0094740 | 6.0712e-04 | TRUE |
| Black - LatinX | -1.7513646 | 0.4534410 | 1,668 | -3.8623869 | 1.1018e-03 | TRUE |
| Black - Other | -2.0762331 | 0.7753192 | 1,668 | -2.6779076 | 5.7685e-02 | FALSE |
| Black - white | -1.9332972 | 0.2159505 | 1,668 | -8.9525032 | 1.6620e-12 | TRUE |
| LatinX - Other | -0.3248685 | 0.8615440 | 1,668 | -0.3770771 | 9.9571e-01 | FALSE |
| LatinX - white | -0.1819326 | 0.4319240 | 1,668 | -0.4212144 | 9.9342e-01 | FALSE |
| Other - white | 0.1429359 | 0.7643550 | 1,668 | 0.1870020 | 9.9973e-01 | 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 Marrinal 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 42.0 0.913 1668 40.2 43.8  
## 37-54 42.6 0.908 1668 40.8 44.4  
## 55-72 42.7 1.007 1668 40.7 44.7  
##   
## Results are averaged over the levels of: gender, race\_eth   
## Confidence level used: 0.95

flextable(SelP\_La\_em1) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("Estimated Marainal Means: SelP\_L and Age Group") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

**Table** : Estimated Marainal Means: SelP\_L and Age Group

| **age\_group** | **emmean** | **SE** | **df** | **lower.CL** | **upper.CL** |
| --- | --- | --- | --- | --- | --- |
| 18-36 | 42.00036 | 0.9125633 | 1,668 | 40.21047 | 43.79025 |
| 37-54 | 42.60026 | 0.9081089 | 1,668 | 40.81910 | 44.38141 |
| 55-72 | 42.71805 | 1.0068063 | 1,668 | 40.74332 | 44.69279 |

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

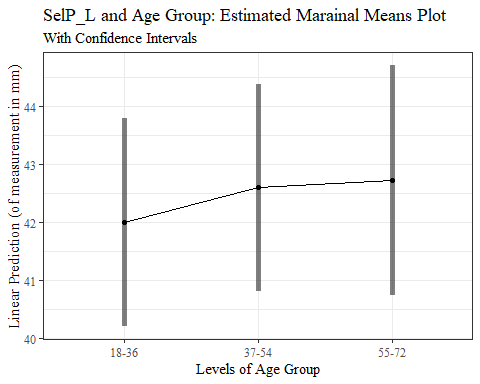
## contrast estimate SE df t.ratio p.value  
## (18-36) - (37-54) -0.600 0.192 1668 -3.130 0.0050  
## (18-36) - (55-72) -0.718 0.463 1668 -1.549 0.2685  
## (37-54) - (55-72) -0.118 0.465 1668 -0.253 0.9653  
##   
## Results are averaged over the levels of: gender, race\_eth   
## P value adjustment: tukey method for comparing a family of 3 estimates

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

| **contrast** | **estimate** | **SE** | **df** | **t.ratio** | **p.value** | **signif** |
| --- | --- | --- | --- | --- | --- | --- |
| (18-36) - (37-54) | -0.5999007 | 0.1916405 | 1,668 | -3.1303445 | 5.0497e-03 | TRUE |
| (18-36) - (55-72) | -0.7176983 | 0.4634279 | 1,668 | -1.5486730 | 2.6854e-01 | FALSE |
| (37-54) - (55-72) | -0.1177976 | 0.4650949 | 1,668 | -0.2532765 | 9.6526e-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 Marainal 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 2 23706 11853 172.54 < 2e-16 \*\*\*  
## race\_eth 4 5121 1280 18.64 5.35e-15 \*\*\*  
## age\_group 2 727 363 5.29 0.00513 \*\*   
## Residuals 1668 114592 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")  
  
#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** : SelM\_L Additive Anova Model Findings

| **term** | **df** | **sumsq** | **meansq** | **f.statistic** | **p.value** | **signif** |
| --- | --- | --- | --- | --- | --- | --- |
| gender | 2 | 23,706.4151 | 11,853.20753 | 172.53579 | 7.8147e-69 | TRUE |
| race\_eth | 4 | 5,121.3804 | 1,280.34511 | 18.63676 | 5.3461e-15 | TRUE |
| age\_group | 2 | 726.7814 | 363.39070 | 5.28953 | 5.1291e-03 | TRUE |
| Residuals | 1,668 | 114,591.5877 | 68.69999 |  | 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 111 0.544 1668 110 113  
## Male 119 0.547 1668 118 120  
## Other 117 5.903 1668 106 129  
##   
## Results are averaged over the levels of: race\_eth, age\_group   
## Confidence level used: 0.95

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

| **gender** | **emmean** | **SE** | **df** | **lower.CL** | **upper.CL** |
| --- | --- | --- | --- | --- | --- |
| Female | 111.4601 | 0.5443987 | 1,668 | 110.3923 | 112.5279 |
| Male | 119.3603 | 0.5470243 | 1,668 | 118.2873 | 120.4332 |
| Other | 117.2142 | 5.9031566 | 1,668 | 105.6359 | 128.7926 |

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

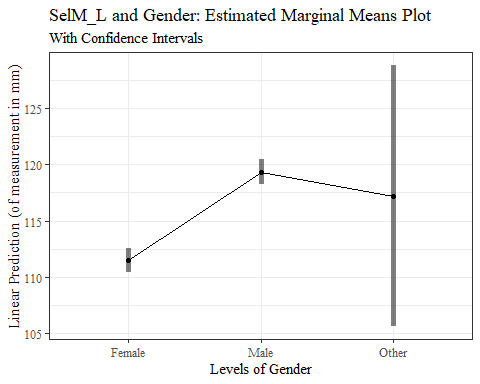
## contrast estimate SE df t.ratio p.value  
## Female - Male -7.90 0.415 1668 -19.021 <.0001  
## Female - Other -5.75 5.928 1668 -0.971 0.5956  
## Male - Other 2.15 5.931 1668 0.362 0.9304  
##   
## Results are averaged over the levels of: race\_eth, age\_group   
## P value adjustment: tukey method for comparing a family of 3 estimates

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

| **contrast** | **estimate** | **SE** | **df** | **t.ratio** | **p.value** | **signif** |
| --- | --- | --- | --- | --- | --- | --- |
| Female - Male | -7.900144 | 0.4153427 | 1,668 | -19.0207836 | 1.6200e-12 | TRUE |
| Female - Other | -5.754120 | 5.9281017 | 1,668 | -0.9706514 | 5.9556e-01 | FALSE |
| Male - Other | 2.146024 | 5.9310873 | 1,668 | 0.3618264 | 9.3039e-01 | FALSE |

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 112 2.20 1668 108 116  
## Black 119 2.03 1668 116 123  
## LatinX 116 2.19 1668 111 120  
## Other 116 2.40 1668 111 121  
## white 117 2.02 1668 113 121  
##   
## Results are averaged over the levels of: gender, age\_group   
## Confidence level used: 0.95

flextable(SelM\_Lr\_em1) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("Estimated Marrinal Means: SelM\_L and Race/Ethnicity") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

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

| **race\_eth** | **emmean** | **SE** | **df** | **lower.CL** | **upper.CL** |
| --- | --- | --- | --- | --- | --- |
| Asian | 112.0431 | 2.204845 | 1,668 | 107.7186 | 116.3677 |
| Black | 119.4757 | 2.025993 | 1,668 | 115.5019 | 123.4494 |
| LatinX | 115.7489 | 2.194253 | 1,668 | 111.4451 | 120.0527 |
| Other | 115.9797 | 2.395424 | 1,668 | 111.2813 | 120.6780 |
| white | 116.8104 | 2.017544 | 1,668 | 112.8532 | 120.7675 |

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

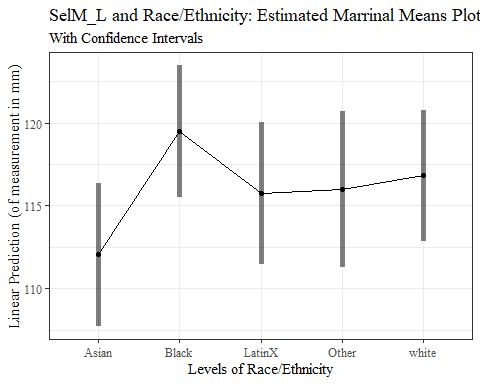
## contrast estimate SE df t.ratio p.value  
## Asian - Black -7.433 1.006 1668 -7.390 <.0001  
## Asian - LatinX -3.706 1.291 1668 -2.869 0.0338  
## Asian - Other -3.937 1.888 1668 -2.085 0.2268  
## Asian - white -4.767 0.960 1668 -4.968 <.0001  
## Black - LatinX 3.727 0.988 1668 3.771 0.0016  
## Black - Other 3.496 1.690 1668 2.069 0.2341  
## Black - white 2.665 0.471 1668 5.663 <.0001  
## LatinX - Other -0.231 1.878 1668 -0.123 0.9999  
## LatinX - white -1.061 0.941 1668 -1.128 0.7919  
## Other - white -0.831 1.666 1668 -0.499 0.9875  
##   
## Results are averaged over the levels of: gender, age\_group   
## P value adjustment: tukey method for comparing a family of 5 estimates

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

| **contrast** | **estimate** | **SE** | **df** | **t.ratio** | **p.value** | **signif** |
| --- | --- | --- | --- | --- | --- | --- |
| Asian - Black | -7.4325734 | 1.0057766 | 1,668 | -7.3898849 | 3.9657e-12 | TRUE |
| Asian - LatinX | -3.7057503 | 1.2914407 | 1,668 | -2.8694700 | 3.3824e-02 | TRUE |
| Asian - Other | -3.9365526 | 1.8876340 | 1,668 | -2.0854428 | 2.2679e-01 | FALSE |
| Asian - white | -4.7672428 | 0.9595638 | 1,668 | -4.9681351 | 7.3814e-06 | TRUE |
| Black - LatinX | 3.7268231 | 0.9881814 | 1,668 | 3.7713956 | 1.5755e-03 | TRUE |
| Black - Other | 3.4960208 | 1.6896487 | 1,668 | 2.0690814 | 2.3406e-01 | FALSE |
| Black - white | 2.6653306 | 0.4706196 | 1,668 | 5.6634496 | 1.7392e-07 | TRUE |
| LatinX - Other | -0.2308023 | 1.8775580 | 1,668 | -0.1229269 | 9.9995e-01 | FALSE |
| LatinX - white | -1.0614925 | 0.9412895 | 1,668 | -1.1277004 | 7.9189e-01 | FALSE |
| Other - white | -0.8306902 | 1.6657546 | 1,668 | -0.4986870 | 9.8750e-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 Marrinal 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  
## 18-36 116 1.99 1668 112 120  
## 37-54 117 1.98 1668 113 121  
## 55-72 115 2.19 1668 111 119  
##   
## Results are averaged over the levels of: gender, race\_eth   
## Confidence level used: 0.95

flextable(SelM\_La\_em1) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("Estimated Marainal Means: SelM\_L and Age Group") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

**Table** : Estimated Marainal Means: SelM\_L and Age Group

| **age\_group** | **emmean** | **SE** | **df** | **lower.CL** | **upper.CL** |
| --- | --- | --- | --- | --- | --- |
| 18-36 | 115.8433 | 1.988744 | 1,668 | 111.9426 | 119.7440 |
| 37-54 | 117.0812 | 1.979037 | 1,668 | 113.1995 | 120.9628 |
| 55-72 | 115.1102 | 2.194127 | 1,668 | 110.8066 | 119.4137 |

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

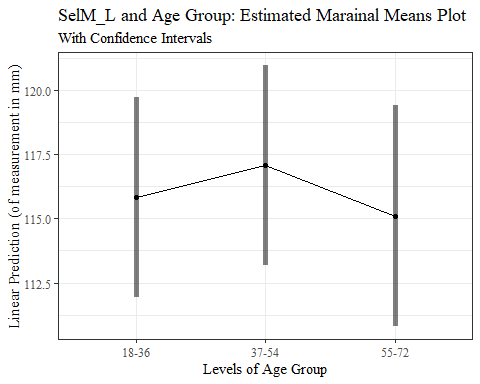
## contrast estimate SE df t.ratio p.value  
## (18-36) - (37-54) -1.238 0.418 1668 -2.964 0.0086  
## (18-36) - (55-72) 0.733 1.010 1668 0.726 0.7482  
## (37-54) - (55-72) 1.971 1.014 1668 1.945 0.1266  
##   
## Results are averaged over the levels of: gender, race\_eth   
## P value adjustment: tukey method for comparing a family of 3 estimates

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

| **contrast** | **estimate** | **SE** | **df** | **t.ratio** | **p.value** | **signif** |
| --- | --- | --- | --- | --- | --- | --- |
| (18-36) - (37-54) | -1.2378630 | 0.417641 | 1,668 | -2.9639404 | 8.6479e-03 | TRUE |
| (18-36) - (55-72) | 0.7331265 | 1.009946 | 1,668 | 0.7259067 | 7.4815e-01 | FALSE |
| (37-54) - (55-72) | 1.9709895 | 1.013579 | 1,668 | 1.9445846 | 1.2664e-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 Marainal 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 2 10832 5416 60.612 <2e-16 \*\*\*  
## race\_eth 4 21805 5451 61.008 <2e-16 \*\*\*  
## age\_group 2 466 233 2.609 0.0739 .   
## Residuals 1668 149042 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")  
  
#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** : SnasM\_C Additive Anova Model Findings

| **term** | **df** | **sumsq** | **meansq** | **f.statistic** | **p.value** | **signif** |
| --- | --- | --- | --- | --- | --- | --- |
| gender | 2 | 10,831.8500 | 5,415.9250 | 60.612345 | 3.8814e-26 | TRUE |
| race\_eth | 4 | 21,805.0374 | 5,451.2594 | 61.007789 | 3.7660e-48 | TRUE |
| age\_group | 2 | 466.2139 | 233.1069 | 2.608817 | 7.3922e-02 | FALSE |
| Residuals | 1,668 | 149,041.6334 | 89.3535 |  | 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 71.4 0.621 1668 70.2 72.6  
## Male 76.5 0.624 1668 75.3 77.7  
## Other 81.8 6.732 1668 68.6 95.0  
##   
## Results are averaged over the levels of: race\_eth, age\_group   
## Confidence level used: 0.95

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

| **gender** | **emmean** | **SE** | **df** | **lower.CL** | **upper.CL** |
| --- | --- | --- | --- | --- | --- |
| Female | 71.37828 | 0.6208612 | 1,668 | 70.16053 | 72.59603 |
| Male | 76.52263 | 0.6238556 | 1,668 | 75.29900 | 77.74625 |
| Other | 81.80022 | 6.7322732 | 1,668 | 68.59563 | 95.00482 |

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

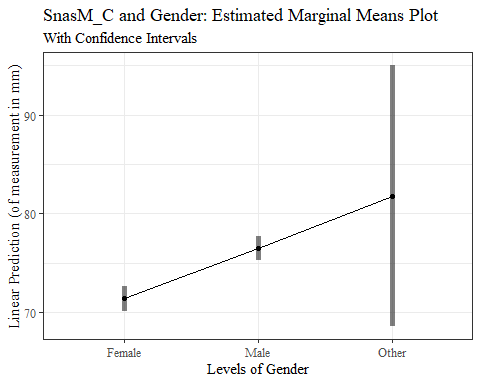
## contrast estimate SE df t.ratio p.value  
## Female - Male -5.14 0.474 1668 -10.860 <.0001  
## Female - Other -10.42 6.761 1668 -1.542 0.2718  
## Male - Other -5.28 6.764 1668 -0.780 0.7152  
##   
## Results are averaged over the levels of: race\_eth, age\_group   
## P value adjustment: tukey method for comparing a family of 3 estimates

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

| **contrast** | **estimate** | **SE** | **df** | **t.ratio** | **p.value** | **signif** |
| --- | --- | --- | --- | --- | --- | --- |
| Female - Male | -5.144348 | 0.4736789 | 1,668 | -10.8604128 | 1.6449e-12 | TRUE |
| Female - Other | -10.421944 | 6.7607220 | 1,668 | -1.5415430 | 2.7178e-01 | FALSE |
| Male - Other | -5.277596 | 6.7641269 | 1,668 | -0.7802331 | 7.1524e-01 | FALSE |

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 73.3 2.51 1668 68.3 78.2  
## Black 83.3 2.31 1668 78.7 87.8  
## LatinX 75.3 2.50 1668 70.4 80.2  
## Other 75.7 2.73 1668 70.4 81.1  
## white 75.3 2.30 1668 70.7 79.8  
##   
## Results are averaged over the levels of: gender, age\_group   
## Confidence level used: 0.95

flextable(SnasM\_Cr\_em1) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("Estimated Marrinal Means: SnasM\_C and Race/Ethnicity") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

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

| **race\_eth** | **emmean** | **SE** | **df** | **lower.CL** | **upper.CL** |
| --- | --- | --- | --- | --- | --- |
| Asian | 73.26413 | 2.514522 | 1,668 | 68.33217 | 78.19608 |
| Black | 83.28165 | 2.310550 | 1,668 | 78.74977 | 87.81354 |
| LatinX | 75.30537 | 2.502443 | 1,668 | 70.39711 | 80.21363 |
| Other | 75.72630 | 2.731869 | 1,668 | 70.36805 | 81.08455 |
| white | 75.25776 | 2.300914 | 1,668 | 70.74478 | 79.77074 |

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

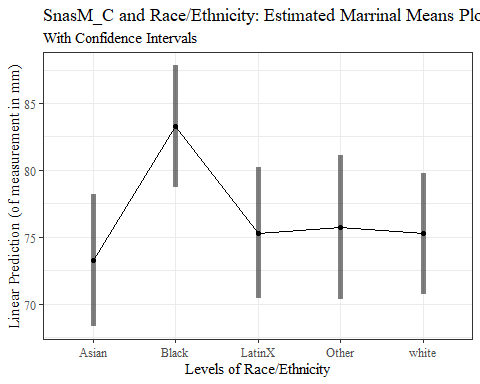
## contrast estimate SE df t.ratio p.value  
## Asian - Black -10.0175 1.147 1668 -8.733 <.0001  
## Asian - LatinX -2.0412 1.473 1668 -1.386 0.6368  
## Asian - Other -2.4622 2.153 1668 -1.144 0.7832  
## Asian - white -1.9936 1.094 1668 -1.822 0.3612  
## Black - LatinX 7.9763 1.127 1668 7.078 <.0001  
## Black - Other 7.5554 1.927 1668 3.921 0.0009  
## Black - white 8.0239 0.537 1668 14.950 <.0001  
## LatinX - Other -0.4209 2.141 1668 -0.197 0.9997  
## LatinX - white 0.0476 1.073 1668 0.044 1.0000  
## Other - white 0.4685 1.900 1668 0.247 0.9992  
##   
## Results are averaged over the levels of: gender, age\_group   
## P value adjustment: tukey method for comparing a family of 5 estimates

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

| **contrast** | **estimate** | **SE** | **df** | **t.ratio** | **p.value** | **signif** |
| --- | --- | --- | --- | --- | --- | --- |
| Asian - Black | -10.01752928 | 1.1470411 | 1,668 | -8.73336595 | 1.6607e-12 | TRUE |
| Asian - LatinX | -2.04124149 | 1.4728275 | 1,668 | -1.38593384 | 6.3682e-01 | FALSE |
| Asian - Other | -2.46217363 | 2.1527580 | 1,668 | -1.14372986 | 7.8317e-01 | FALSE |
| Asian - white | -1.99363498 | 1.0943376 | 1,668 | -1.82177333 | 3.6122e-01 | FALSE |
| Black - LatinX | 7.97628779 | 1.1269746 | 1,668 | 7.07761112 | 2.3172e-11 | TRUE |
| Black - Other | 7.55535565 | 1.9269652 | 1,668 | 3.92085743 | 8.7169e-04 | TRUE |
| Black - white | 8.02389430 | 0.5367196 | 1,668 | 14.94988060 | 1.6200e-12 | TRUE |
| LatinX - Other | -0.42093214 | 2.1412668 | 1,668 | -0.19658089 | 9.9967e-01 | FALSE |
| LatinX - white | 0.04760651 | 1.0734965 | 1,668 | 0.04434714 | 1.0000e+00 | FALSE |
| Other - white | 0.46853864 | 1.8997150 | 1,668 | 0.24663628 | 9.9918e-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 Marrinal 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 2 74843 37422 308.17 <2e-16 \*\*\*  
## race\_eth 4 10511 2628 21.64 <2e-16 \*\*\*  
## age\_group 2 18068 9034 74.40 <2e-16 \*\*\*  
## Residuals 1668 202548 121   
## ---  
## 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")  
  
#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** : TrSman\_C Additive Anova Model Findings

| **term** | **df** | **sumsq** | **meansq** | **f.statistic** | **p.value** | **signif** |
| --- | --- | --- | --- | --- | --- | --- |
| gender | 2 | 74,843.30 | 37,421.6479 | 308.1711 | 1.2726e-114 | TRUE |
| race\_eth | 4 | 10,510.76 | 2,627.6899 | 21.6393 | 1.9976e-17 | TRUE |
| age\_group | 2 | 18,068.24 | 9,034.1190 | 74.3969 | 1.1236e-31 | TRUE |
| Residuals | 1,668 | 202,547.56 | 121.4314 |  | 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 147 0.724 1668 145 148  
## Male 161 0.727 1668 159 162  
## Other 161 7.848 1668 146 177  
##   
## Results are averaged over the levels of: race\_eth, age\_group   
## Confidence level used: 0.95

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

| **gender** | **emmean** | **SE** | **df** | **lower.CL** | **upper.CL** |
| --- | --- | --- | --- | --- | --- |
| Female | 146.6987 | 0.7237761 | 1,668 | 145.2791 | 148.1183 |
| Male | 160.6836 | 0.7272668 | 1,668 | 159.2571 | 162.1100 |
| Other | 161.2987 | 7.8482249 | 1,668 | 145.9053 | 176.6921 |

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

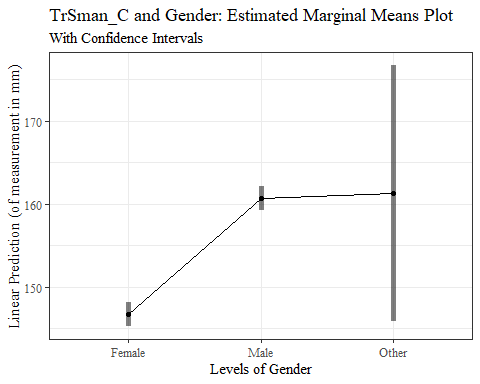
## contrast estimate SE df t.ratio p.value  
## Female - Male -13.985 0.552 1668 -25.326 <.0001  
## Female - Other -14.600 7.881 1668 -1.852 0.1531  
## Male - Other -0.615 7.885 1668 -0.078 0.9967  
##   
## Results are averaged over the levels of: race\_eth, age\_group   
## P value adjustment: tukey method for comparing a family of 3 estimates

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

| **contrast** | **estimate** | **SE** | **df** | **t.ratio** | **p.value** | **signif** |
| --- | --- | --- | --- | --- | --- | --- |
| Female - Male | -13.9848963 | 0.5521966 | 1,668 | -25.32593589 | 1.6200e-12 | TRUE |
| Female - Other | -14.6000034 | 7.8813894 | 1,668 | -1.85246570 | 1.5309e-01 | FALSE |
| Male - Other | -0.6151072 | 7.8853587 | 1,668 | -0.07800624 | 9.9665e-01 | FALSE |

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 154 2.93 1668 148 160  
## Black 161 2.69 1668 156 166  
## LatinX 156 2.92 1668 150 162  
## Other 154 3.18 1668 147 160  
## white 156 2.68 1668 151 162  
##   
## Results are averaged over the levels of: gender, age\_group   
## Confidence level used: 0.95

flextable(TrSman\_Cr\_em1) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("Estimated Marrinal Means: TrSman\_C and Race/Ethnicity") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

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

| **race\_eth** | **emmean** | **SE** | **df** | **lower.CL** | **upper.CL** |
| --- | --- | --- | --- | --- | --- |
| Asian | 154.1940 | 2.931333 | 1,668 | 148.4445 | 159.9434 |
| Black | 161.0611 | 2.693550 | 1,668 | 155.7780 | 166.3442 |
| LatinX | 155.8730 | 2.917251 | 1,668 | 150.1511 | 161.5949 |
| Other | 153.5210 | 3.184707 | 1,668 | 147.2745 | 159.7674 |
| white | 156.4859 | 2.682317 | 1,668 | 151.2249 | 161.7470 |

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

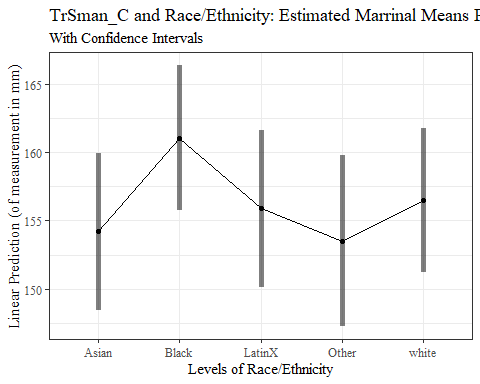
## contrast estimate SE df t.ratio p.value  
## Asian - Black -6.867 1.337 1668 -5.136 <.0001  
## Asian - LatinX -1.679 1.717 1668 -0.978 0.8653  
## Asian - Other 0.673 2.510 1668 0.268 0.9989  
## Asian - white -2.292 1.276 1668 -1.797 0.3758  
## Black - LatinX 5.188 1.314 1668 3.949 0.0008  
## Black - Other 7.540 2.246 1668 3.357 0.0072  
## Black - white 4.575 0.626 1668 7.312 <.0001  
## LatinX - Other 2.352 2.496 1668 0.942 0.8803  
## LatinX - white -0.613 1.251 1668 -0.490 0.9883  
## Other - white -2.965 2.215 1668 -1.339 0.6669  
##   
## Results are averaged over the levels of: gender, age\_group   
## P value adjustment: tukey method for comparing a family of 5 estimates

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

| **contrast** | **estimate** | **SE** | **df** | **t.ratio** | **p.value** | **signif** |
| --- | --- | --- | --- | --- | --- | --- |
| Asian - Black | -6.8671437 | 1.3371763 | 1,668 | -5.1355560 | 3.1204e-06 | TRUE |
| Asian - LatinX | -1.6790413 | 1.7169656 | 1,668 | -0.9779120 | 8.6526e-01 | FALSE |
| Asian - Other | 0.6729880 | 2.5096024 | 1,668 | 0.2681652 | 9.9887e-01 | FALSE |
| Asian - white | -2.2919707 | 1.2757366 | 1,668 | -1.7965862 | 3.7584e-01 | FALSE |
| Black - LatinX | 5.1881023 | 1.3137836 | 1,668 | 3.9489780 | 7.7784e-04 | TRUE |
| Black - Other | 7.5401317 | 2.2463818 | 1,668 | 3.3565673 | 7.2067e-03 | TRUE |
| Black - white | 4.5751729 | 0.6256871 | 1,668 | 7.3122383 | 5.7134e-12 | TRUE |
| LatinX - Other | 2.3520293 | 2.4962064 | 1,668 | 0.9422415 | 8.8035e-01 | FALSE |
| LatinX - white | -0.6129294 | 1.2514409 | 1,668 | -0.4897789 | 9.8832e-01 | FALSE |
| Other - white | -2.9649587 | 2.2146146 | 1,668 | -1.3388147 | 6.6692e-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 Marrinal 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  
## 18-36 151 2.64 1668 146 157  
## 37-54 158 2.63 1668 153 163  
## 55-72 159 2.92 1668 154 165  
##   
## Results are averaged over the levels of: gender, race\_eth   
## Confidence level used: 0.95

flextable(TrSman\_Ca\_em1) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("Estimated Marainal Means: TrSman\_C and Age Group") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

**Table** : Estimated Marainal Means: TrSman\_C and Age Group

| **age\_group** | **emmean** | **SE** | **df** | **lower.CL** | **upper.CL** |
| --- | --- | --- | --- | --- | --- |
| 18-36 | 151.4143 | 2.644028 | 1,668 | 146.2283 | 156.6003 |
| 37-54 | 157.8643 | 2.631122 | 1,668 | 152.7036 | 163.0249 |
| 55-72 | 159.4024 | 2.917084 | 1,668 | 153.6809 | 165.1239 |

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

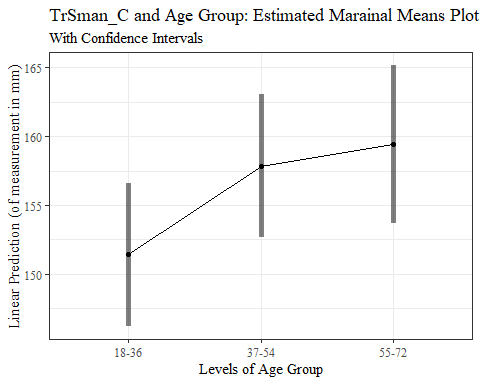
## contrast estimate SE df t.ratio p.value  
## (18-36) - (37-54) -6.45 0.555 1668 -11.616 <.0001  
## (18-36) - (55-72) -7.99 1.343 1668 -5.949 <.0001  
## (37-54) - (55-72) -1.54 1.348 1668 -1.141 0.4887  
##   
## Results are averaged over the levels of: gender, race\_eth   
## P value adjustment: tukey method for comparing a family of 3 estimates

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

| **contrast** | **estimate** | **SE** | **df** | **t.ratio** | **p.value** | **signif** |
| --- | --- | --- | --- | --- | --- | --- |
| (18-36) - (37-54) | -6.449964 | 0.5552522 | 1,668 | -11.616280 | 1.6203e-12 | TRUE |
| (18-36) - (55-72) | -7.988127 | 1.3427193 | 1,668 | -5.949216 | 9.8249e-09 | TRUE |
| (37-54) - (55-72) | -1.538162 | 1.3475491 | 1,668 | -1.141452 | 4.8866e-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 Marainal 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 2 77012 38506 281.492 < 2e-16 \*\*\*  
## race\_eth 4 18171 4543 33.210 < 2e-16 \*\*\*  
## age\_group 2 2631 1315 9.615 7.05e-05 \*\*\*  
## Residuals 1668 228169 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")  
  
#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** : TrTr\_C Additive Anova Model Findings

| **term** | **df** | **sumsq** | **meansq** | **f.statistic** | **p.value** | **signif** |
| --- | --- | --- | --- | --- | --- | --- |
| gender | 2 | 77,011.639 | 38,505.8197 | 281.492092 | 4.6284e-106 | TRUE |
| race\_eth | 4 | 18,171.302 | 4,542.8254 | 33.209770 | 1.1001e-26 | TRUE |
| age\_group | 2 | 2,630.552 | 1,315.2759 | 9.615164 | 7.0482e-05 | TRUE |
| Residuals | 1,668 | 228,168.780 | 136.7918 |  | 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 276 0.768 1668 274 278  
## Male 290 0.772 1668 288 291  
## Other 285 8.330 1668 269 301  
##   
## Results are averaged over the levels of: race\_eth, age\_group   
## Confidence level used: 0.95

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

| **gender** | **emmean** | **SE** | **df** | **lower.CL** | **upper.CL** |
| --- | --- | --- | --- | --- | --- |
| Female | 276.0018 | 0.7681903 | 1,668 | 274.4951 | 277.5085 |
| Male | 289.7641 | 0.7718953 | 1,668 | 288.2502 | 291.2781 |
| Other | 285.0339 | 8.3298282 | 1,668 | 268.6959 | 301.3720 |

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

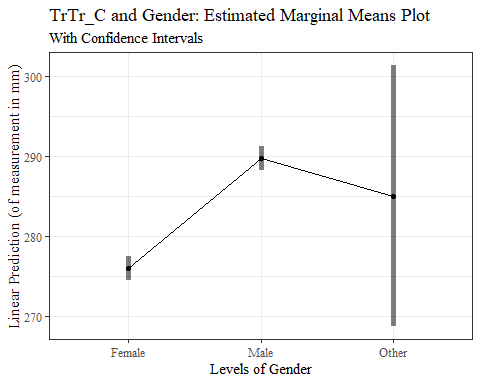
## contrast estimate SE df t.ratio p.value  
## Female - Male -13.76 0.586 1668 -23.482 <.0001  
## Female - Other -9.03 8.365 1668 -1.080 0.5268  
## Male - Other 4.73 8.369 1668 0.565 0.8386  
##   
## Results are averaged over the levels of: race\_eth, age\_group   
## P value adjustment: tukey method for comparing a family of 3 estimates

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

| **contrast** | **estimate** | **SE** | **df** | **t.ratio** | **p.value** | **signif** |
| --- | --- | --- | --- | --- | --- | --- |
| Female - Male | -13.762342 | 0.586082 | 1,668 | -23.481942 | 1.6200e-12 | TRUE |
| Female - Other | -9.032140 | 8.365028 | 1,668 | -1.079750 | 5.2678e-01 | FALSE |
| Male - Other | 4.730202 | 8.369241 | 1,668 | 0.565189 | 8.3864e-01 | FALSE |

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 282 3.11 1668 276 288  
## Black 290 2.86 1668 284 296  
## LatinX 282 3.10 1668 276 288  
## Other 281 3.38 1668 274 288  
## white 283 2.85 1668 277 288  
##   
## Results are averaged over the levels of: gender, age\_group   
## Confidence level used: 0.95

flextable(TrTr\_Cr\_em1) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("Estimated Marrinal Means: TrTr\_C and Race/Ethnicity") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

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

| **race\_eth** | **emmean** | **SE** | **df** | **lower.CL** | **upper.CL** |
| --- | --- | --- | --- | --- | --- |
| Asian | 281.9469 | 3.111213 | 1,668 | 275.8446 | 288.0491 |
| Black | 289.9532 | 2.858838 | 1,668 | 284.3459 | 295.5605 |
| LatinX | 282.3757 | 3.096267 | 1,668 | 276.3028 | 288.4487 |
| Other | 280.8905 | 3.380136 | 1,668 | 274.2608 | 287.5203 |
| white | 282.8335 | 2.846916 | 1,668 | 277.2496 | 288.4174 |

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

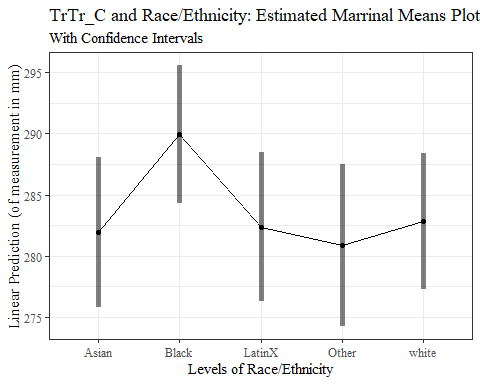
## contrast estimate SE df t.ratio p.value  
## Asian - Black -8.006 1.419 1668 -5.641 <.0001  
## Asian - LatinX -0.429 1.822 1668 -0.235 0.9993  
## Asian - Other 1.056 2.664 1668 0.397 0.9948  
## Asian - white -0.887 1.354 1668 -0.655 0.9658  
## Black - LatinX 7.577 1.394 1668 5.434 <.0001  
## Black - Other 9.063 2.384 1668 3.801 0.0014  
## Black - white 7.120 0.664 1668 10.721 <.0001  
## LatinX - Other 1.485 2.649 1668 0.561 0.9806  
## LatinX - white -0.458 1.328 1668 -0.345 0.9970  
## Other - white -1.943 2.351 1668 -0.827 0.9224  
##   
## Results are averaged over the levels of: gender, age\_group   
## P value adjustment: tukey method for comparing a family of 5 estimates

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

| **contrast** | **estimate** | **SE** | **df** | **t.ratio** | **p.value** | **signif** |
| --- | --- | --- | --- | --- | --- | --- |
| Asian - Black | -8.0063555 | 1.4192316 | 1,668 | -5.6413312 | 1.9731e-07 | TRUE |
| Asian - LatinX | -0.4288901 | 1.8223265 | 1,668 | -0.2353530 | 9.9932e-01 | FALSE |
| Asian - Other | 1.0563309 | 2.6636032 | 1,668 | 0.3965797 | 9.9478e-01 | FALSE |
| Asian - white | -0.8866257 | 1.3540217 | 1,668 | -0.6548091 | 9.6577e-01 | FALSE |
| Black - LatinX | 7.5774654 | 1.3944034 | 1,668 | 5.4341989 | 6.2915e-07 | TRUE |
| Black - Other | 9.0626863 | 2.3842301 | 1,668 | 3.8010955 | 1.4032e-03 | TRUE |
| Black - white | 7.1197297 | 0.6640821 | 1,668 | 10.7211587 | 1.6644e-12 | TRUE |
| LatinX - Other | 1.4852209 | 2.6493852 | 1,668 | 0.5605908 | 9.8063e-01 | FALSE |
| LatinX - white | -0.4577356 | 1.3282351 | 1,668 | -0.3446194 | 9.9697e-01 | FALSE |
| Other - white | -1.9429566 | 2.3505136 | 1,668 | -0.8266094 | 9.2245e-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 Marrinal 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  
## 18-36 281 2.81 1668 276 287  
## 37-54 283 2.79 1668 277 288  
## 55-72 287 3.10 1668 281 293  
##   
## Results are averaged over the levels of: gender, race\_eth   
## Confidence level used: 0.95

flextable(TrTr\_Ca\_em1) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("Estimated Marainal Means: TrTr\_C and Age Group") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

**Table** : Estimated Marainal Means: TrTr\_C and Age Group

| **age\_group** | **emmean** | **SE** | **df** | **lower.CL** | **upper.CL** |
| --- | --- | --- | --- | --- | --- |
| 18-36 | 281.2013 | 2.806278 | 1,668 | 275.6971 | 286.7055 |
| 37-54 | 282.7441 | 2.792580 | 1,668 | 277.2668 | 288.2214 |
| 55-72 | 286.8545 | 3.096090 | 1,668 | 280.7819 | 292.9271 |

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

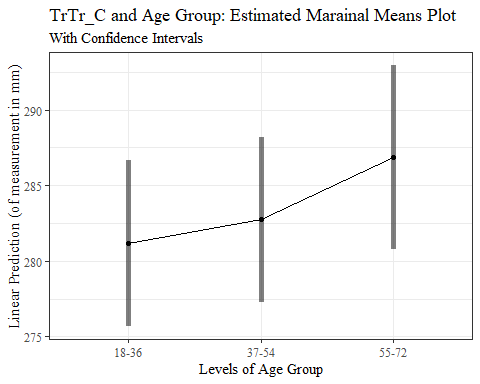
## contrast estimate SE df t.ratio p.value  
## (18-36) - (37-54) -1.54 0.589 1668 -2.618 0.0242  
## (18-36) - (55-72) -5.65 1.425 1668 -3.967 0.0002  
## (37-54) - (55-72) -4.11 1.430 1668 -2.874 0.0114  
##   
## Results are averaged over the levels of: gender, race\_eth   
## P value adjustment: tukey method for comparing a family of 3 estimates

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

| **contrast** | **estimate** | **SE** | **df** | **t.ratio** | **p.value** | **signif** |
| --- | --- | --- | --- | --- | --- | --- |
| (18-36) - (37-54) | -1.542833 | 0.589325 | 1,668 | -2.617966 | 2.4219e-02 | TRUE |
| (18-36) - (55-72) | -5.653201 | 1.425115 | 1,668 | -3.966839 | 2.2393e-04 | TRUE |
| (37-54) - (55-72) | -4.110368 | 1.430241 | 1,668 | -2.873899 | 1.1438e-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 Marainal 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 2 37801 18900 562.840 < 2e-16 \*\*\*  
## race\_eth 4 2325 581 17.310 6.36e-14 \*\*\*  
## age\_group 2 446 223 6.639 0.00134 \*\*   
## Residuals 1668 56012 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")  
  
#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** : TrTr\_L Additive Anova Model Findings

| **term** | **df** | **sumsq** | **meansq** | **f.statistic** | **p.value** | **signif** |
| --- | --- | --- | --- | --- | --- | --- |
| gender | 2 | 37,800.9776 | 18,900.48881 | 562.839755 | 1.5857e-187 | TRUE |
| race\_eth | 4 | 2,325.0772 | 581.26929 | 17.309683 | 6.3563e-14 | TRUE |
| age\_group | 2 | 445.8509 | 222.92547 | 6.638522 | 1.3438e-03 | TRUE |
| Residuals | 1,668 | 56,012.4175 | 33.58059 |  | 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 142.4 0.3806 1668 141.7 143.2  
## Male 152.0 0.3824 1668 151.3 152.8  
## Other 146.6 4.1271 1668 138.5 154.7  
##   
## Results are averaged over the levels of: race\_eth, age\_group   
## Confidence level used: 0.95

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

| **gender** | **emmean** | **SE** | **df** | **lower.CL** | **upper.CL** |
| --- | --- | --- | --- | --- | --- |
| Female | 142.4059 | 0.3806123 | 1,668 | 141.6594 | 143.1524 |
| Male | 152.0307 | 0.3824480 | 1,668 | 151.2805 | 152.7808 |
| Other | 146.5694 | 4.1271485 | 1,668 | 138.4745 | 154.6643 |

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

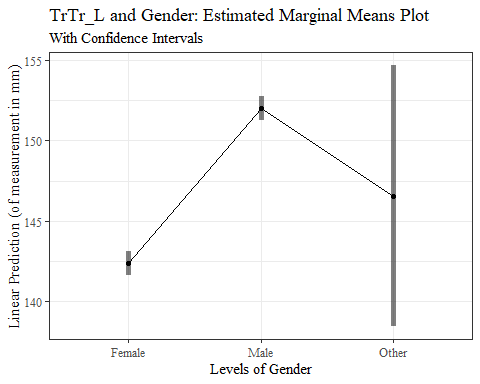
## contrast estimate SE df t.ratio p.value  
## Female - Male -9.62 0.29 1668 -33.145 <.0001  
## Female - Other -4.16 4.14 1668 -1.005 0.5741  
## Male - Other 5.46 4.15 1668 1.317 0.3858  
##   
## Results are averaged over the levels of: race\_eth, age\_group   
## P value adjustment: tukey method for comparing a family of 3 estimates

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

| **contrast** | **estimate** | **SE** | **df** | **t.ratio** | **p.value** | **signif** |
| --- | --- | --- | --- | --- | --- | --- |
| Female - Male | -9.624753 | 0.2903838 | 1,668 | -33.144936 | 1.6200e-12 | TRUE |
| Female - Other | -4.163478 | 4.1445887 | 1,668 | -1.004558 | 5.7407e-01 | FALSE |
| Male - Other | 5.461275 | 4.1466760 | 1,668 | 1.317025 | 3.8584e-01 | FALSE |

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 1.54 1668 144 150  
## Black 149 1.42 1668 146 151  
## LatinX 147 1.53 1668 144 150  
## Other 146 1.67 1668 143 150  
## white 146 1.41 1668 143 149  
##   
## Results are averaged over the levels of: gender, age\_group   
## Confidence level used: 0.95

flextable(TrTr\_Lr\_em1) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("Estimated Marrinal Means: TrTr\_L and Race/Ethnicity") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

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

| **race\_eth** | **emmean** | **SE** | **df** | **lower.CL** | **upper.CL** |
| --- | --- | --- | --- | --- | --- |
| Asian | 147.1930 | 1.541501 | 1,668 | 144.1695 | 150.2165 |
| Black | 148.6989 | 1.416458 | 1,668 | 145.9207 | 151.4772 |
| LatinX | 146.6298 | 1.534096 | 1,668 | 143.6209 | 149.6388 |
| Other | 146.4387 | 1.674743 | 1,668 | 143.1538 | 149.7235 |
| white | 146.0495 | 1.410551 | 1,668 | 143.2829 | 148.8162 |

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

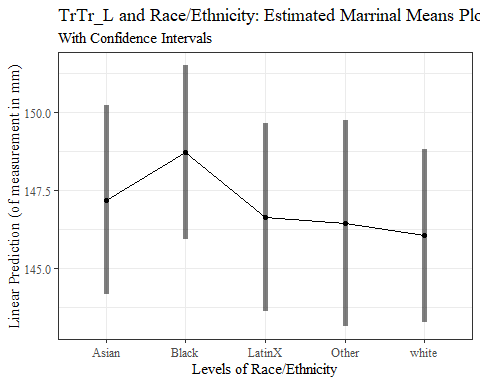
## contrast estimate SE df t.ratio p.value  
## Asian - Black -1.506 0.703 1668 -2.142 0.2030  
## Asian - LatinX 0.563 0.903 1668 0.624 0.9713  
## Asian - Other 0.754 1.320 1668 0.572 0.9792  
## Asian - white 1.144 0.671 1668 1.705 0.4314  
## Black - LatinX 2.069 0.691 1668 2.995 0.0233  
## Black - Other 2.260 1.181 1668 1.913 0.3105  
## Black - white 2.649 0.329 1668 8.052 <.0001  
## LatinX - Other 0.191 1.313 1668 0.146 0.9999  
## LatinX - white 0.580 0.658 1668 0.882 0.9037  
## Other - white 0.389 1.165 1668 0.334 0.9973  
##   
## Results are averaged over the levels of: gender, age\_group   
## P value adjustment: tukey method for comparing a family of 5 estimates

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

| **contrast** | **estimate** | **SE** | **df** | **t.ratio** | **p.value** | **signif** |
| --- | --- | --- | --- | --- | --- | --- |
| Asian - Black | -1.5059154 | 0.7031813 | 1,668 | -2.1415748 | 2.0301e-01 | FALSE |
| Asian - LatinX | 0.5632209 | 0.9029012 | 1,668 | 0.6237901 | 9.7130e-01 | FALSE |
| Asian - Other | 0.7543623 | 1.3197254 | 1,668 | 0.5716055 | 9.7918e-01 | FALSE |
| Asian - white | 1.1435161 | 0.6708720 | 1,668 | 1.7045220 | 4.3137e-01 | FALSE |
| Black - LatinX | 2.0691363 | 0.6908798 | 1,668 | 2.9949296 | 2.3300e-02 | TRUE |
| Black - Other | 2.2602777 | 1.1813055 | 1,668 | 1.9133727 | 3.1049e-01 | FALSE |
| Black - white | 2.6494314 | 0.3290303 | 1,668 | 8.0522427 | 1.6978e-12 | TRUE |
| LatinX - Other | 0.1911414 | 1.3126808 | 1,668 | 0.1456115 | 9.9990e-01 | FALSE |
| LatinX - white | 0.5802952 | 0.6580956 | 1,668 | 0.8817794 | 9.0368e-01 | FALSE |
| Other - white | 0.3891537 | 1.1646001 | 1,668 | 0.3341523 | 9.9732e-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 Marrinal 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 1.39 1668 143 149  
## 37-54 147 1.38 1668 144 150  
## 55-72 148 1.53 1668 145 151  
##   
## Results are averaged over the levels of: gender, race\_eth   
## Confidence level used: 0.95

flextable(TrTr\_La\_em1) %>%  
 my\_ft\_theme()%>%   
 bold(part = "header") %>%   
 set\_caption("Estimated Marainal Means: TrTr\_L and Age Group") %>%   
 fit\_to\_width(7.5) %>%   
 autofit()

**Table** : Estimated Marainal Means: TrTr\_L and Age Group

| **age\_group** | **emmean** | **SE** | **df** | **lower.CL** | **upper.CL** |
| --- | --- | --- | --- | --- | --- |
| 18-36 | 146.0571 | 1.390416 | 1,668 | 143.3299 | 148.7842 |
| 37-54 | 146.8658 | 1.383629 | 1,668 | 144.1520 | 149.5796 |
| 55-72 | 148.0831 | 1.534008 | 1,668 | 145.0743 | 151.0919 |

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) -0.809 0.292 1668 -2.770 0.0157  
## (18-36) - (55-72) -2.026 0.706 1668 -2.869 0.0116  
## (37-54) - (55-72) -1.217 0.709 1668 -1.718 0.1988  
##   
## Results are averaged over the levels of: gender, race\_eth   
## P value adjustment: tukey method for comparing a family of 3 estimates

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

| **contrast** | **estimate** | **SE** | **df** | **t.ratio** | **p.value** | **signif** |
| --- | --- | --- | --- | --- | --- | --- |
| (18-36) - (37-54) | -0.8087088 | 0.2919906 | 1,668 | -2.769640 | 1.5651e-02 | TRUE |
| (18-36) - (55-72) | -2.0260414 | 0.7060962 | 1,668 | -2.869356 | 1.1598e-02 | TRUE |
| (37-54) - (55-72) | -1.2173326 | 0.7086361 | 1,668 | -1.717853 | 1.9876e-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 Marainal Means Plot",  
 subtitle="With Confidence Intervals",  
 y="Linear Prediction (of measurement in mm)",  
 x="Levels of Age Group")

