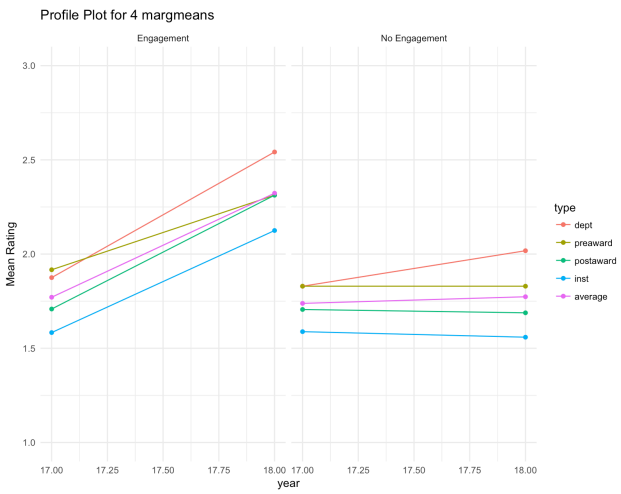
HR Analytics Final

Levent Kayın

In this final assignment I will be analysing the effects of centralising research support under RAS at Emory University. For analysis we will follow the questions posed in the assignment to get an overall view of the project and finally conclude by summarising and assessing the whole project at the end.

Question1 - Faculty satisfaction in general



As seen in the profile plot to the left, faculty who has taken part in the engagement schedule has significantly increased satisfaction scores across all four categories. The most improved category is departmental satisfaction.

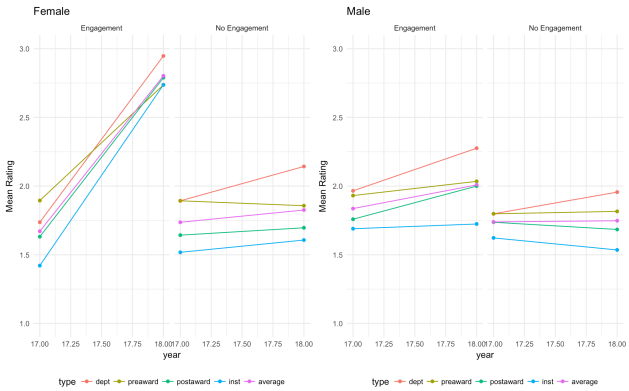
In faculty that has not taken part in the treatment we still see an increase in departmental satisfaction. However, we see slight decreases in all satisfaction categories.

In first glance these results shows promise in the treatment and the new system. For detailed statistics see table Q1-summary in the Appendix

---

Question 2 - Faculty satisfaction by gender and tenure track

GENDER




```
> gender_emmeans17
 female dMtg             emmean         SE  df asymp.LCL asymp.UCL
 Male   No Engagement 1.751585 0.04104856 Inf  1.671131  1.832038
 Female No Engagement 1.711060 0.05597562 Inf  1.601350  1.820770
 Male   Engagement    1.786874 0.07072037 Inf  1.648265  1.925484
 Female Engagement    1.746350 0.07671858 Inf  1.595984  1.896715

Confidence level used: 0.95
> gender_emmeans18
 female dMtg             emmean         SE  df asymp.LCL asymp.UCL
 Male   No Engagement 1.692595 0.04690930 Inf  1.600654  1.784535
 Female No Engagement 1.938289 0.06396758 Inf  1.812915  2.063664
 Male   Engagement    2.225662 0.08081753 Inf  2.067263  2.384062
 Female Engagement    2.471357 0.08767214 Inf  2.299523  2.643192

Confidence level used: 0.95
```

On the profile plot to the left we see a significant increase in female faculty who have taken part in the treatment. This seems to confirm the initial hypothesis that less privileged groups would be more satisfied by the new system. However, we also see that females who were not given the treatment behave similarly to males and only see slight increases in satisfaction. This indicates that the treatment might be an important factor in the new model.

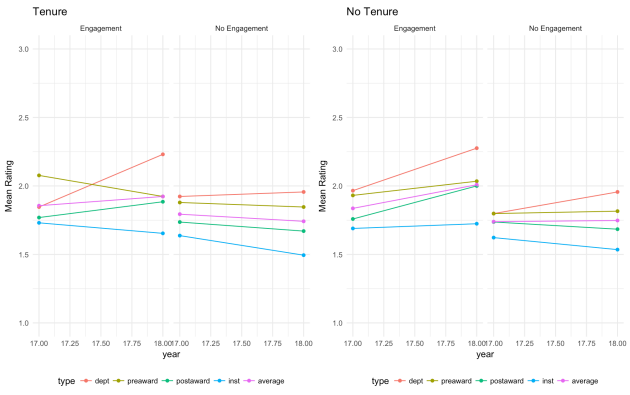
In male faculty we see slightly increased satisfaction in faculty who are part of the engagement and slight increases and slight (usually negative) decrease in satisfaction in those who are not part of the treatment.

To the left you can see the estimated means for genders and treatment participation for both years. As expected we see a difference between the actual and estimated means. However, these differences are quite small (as well as the standard errors).

See Q2 - Gender Tables and Plots for more detailed information including a MONOVA analysis and within-subject plots.

TENURE

As seen on the plots to the left, the significant increase in satisfaction seen in the female faculty is not replicated when the faculty is separated by tenure track. Still, the “underprivileged” non tenure track faculty who have taken part in the treatment sees a small increase in satisfaction




```
> tenure_emmeans17
 tenuretrack  dMtg             emmean         SE  df asymp.LCL asymp.UCL
 No Tenure    No Engagement 1.666353 0.04772879 Inf  1.572806  1.759900
 Tenure Track No Engagement 1.800638 0.04486001 Inf  1.712714  1.888562
 No Tenure    Engagement    1.698095 0.07316685 Inf  1.554691  1.841500
 Tenure Track Engagement    1.832381 0.07099164 Inf  1.693240  1.971522

Confidence level used: 0.95
> tenure_emmeans18
 tenuretrack  dMtg             emmean         SE  df asymp.LCL asymp.UCL
 No Tenure    No Engagement 1.904744 0.05495803 Inf  1.797028  2.012459
 Tenure Track No Engagement 1.659618 0.05165473 Inf  1.558377  1.760860
 No Tenure    Engagement    2.455693 0.08424907 Inf  2.290568  2.620818
 Tenure Track Engagement    2.210567 0.08174438 Inf  2.050351  2.370783
```

We see a curious decrease in post award satisfaction in faculty who takes part in the treatment and are on a tenure track. This should be investigated further.

To the left we again see the estimated means. There is not much more to discuss here other than the same insights from gender estimates.

See Q2 - Tenure Tables and Plots for more detailed information including a MONOVA analysis and within-subject plots.

Question 3 - Regression Models to see effects of the treatment

I have used ordered logistic models to predict average and departmental satisfaction for selected variables. See appendix Q3 - Aspect Models for specific models targeting the aspects. Here we will discuss the average satisfaction.

```
> summary(avg_model)

Re-fitting to get Hessian

Call:
polr(formula = delt_avg ~ female + white + asian + yos + chair +
    tenuretrack + dMtg, data = modeldata)

Coefficients:
                          Value Std. Error t value
femaleFemale            0.71714    0.28919  2.4799
whiteWhite             -0.57262    0.48265 -1.1864
asianAsian             -0.34547    0.59383 -0.5818
yos                     0.01177    0.01531  0.7686
chairChair             -0.16218    0.58600 -0.2768
tenuretrackTenure Track -0.94921    0.30091 -3.1545
dMtgEngagement          1.24778    0.34169  3.6518

Intercepts:
      Value   Std. Error t value
-2|-1 -4.7676  0.7958    -5.9913
-1|0  -2.0987  0.5765    -3.6402
0|1    0.9496  0.5574     1.7035
1|2    2.6250  0.6006     4.3707

Residual Deviance: 468.9255
AIC: 490.9255
```

We see that overall taking part in the treatment seems to increase the overall satisfaction, this is also confirmed by the plot in Q1.

Based on the model coefficients and statistics:
-We see that females are also more likely to have increased satisfaction.
-We also see that increased satisfaction is less likely for tenure track faculty.
-Again, the effects mentioned above hold true when applied together. So, female faculty that are not in the tenure track are more likely to increase satisfaction.

Question 4 - Estimation Models

See appendix Q4 -Models for detailed model summaries.

	Most important factors
Number of Proposals	Ras unit CAPS seems to be highly negatively correlated with number of proposals and highly indicative in the model. Chairs seem to submit more proposals than others as well.
Number of awards	There is a significant correlation with being in Dept. of Medicine and number of awards and having an M.D. This seems appropriate with Emory's focus on medicine. Being asian seems to be correlated with high award numbers as well.
Proposal amounts	High positive correlation with RAS unit Yerkes and Dept of Medicine, Chairs and being in tenure track.
Award Amounts	Again highly correlated with being in Dept. of Medicine and having a M.D.

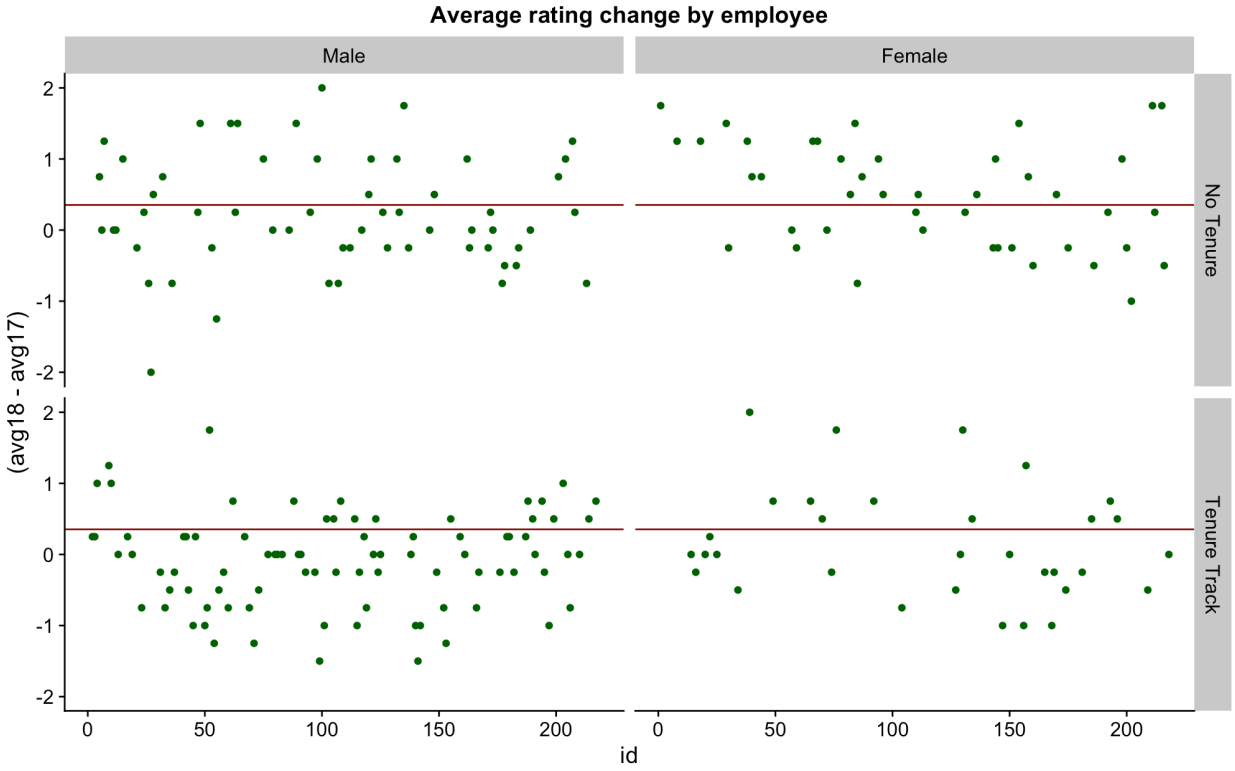
Q5 - Overall Summary

In general we see increase in satisfaction for underprivileged groups and hypothesise that the reduced satisfaction in privileged groups will increase with time and the treatment. So we are confident in the success od RAS provided that the engagement is observed by every department.

Appendix Q1

```
> summ_alldata
   year margmean    stddev      type          dMtg
1    17 1.875000 0.6724044      dept    Engagement
2    18 2.541667 0.6828705      dept    Engagement
3    17 1.916667 0.6789646  preaward    Engagement
4    18 2.312500 0.7482248  preaward    Engagement
5    17 1.708333 0.6828705 postaward    Engagement
6    18 2.312500 0.7482248 postaward    Engagement
7    17 1.583333 0.7096098      inst    Engagement
8    18 2.125000 0.7888856      inst    Engagement
9    17 1.770833 0.5229655   average    Engagement
10   18 2.322917 0.6440363   average    Engagement
11   17 1.829412 0.6345708      dept No Engagement
12   18 2.017647 0.6387259      dept No Engagement
13   17 1.829412 0.6795967  preaward No Engagement
14   18 1.829412 0.7299710  preaward No Engagement
15   17 1.705882 0.6849788 postaward No Engagement
16   18 1.688235 0.6985889 postaward No Engagement
17   17 1.588235 0.5713913      inst No Engagement
18   18 1.558824 0.6339123      inst No Engagement
19   17 1.738235 0.4349826   average No Engagement
20   18 1.773529 0.4979596   average No Engagement
```

Appendix Q2




```
> summary.aov(gendermanova)
 Response preaward17 :
            Df Sum Sq Mean Sq F value Pr(>F)
female       1  0.229 0.22855  0.4938  0.483
dMtg         1  0.257 0.25704  0.5553  0.457
Residuals  215 99.519 0.46288

 Response postaward17 :
            Df  Sum Sq Mean Sq F value Pr(>F)
female       1   0.504 0.50444  1.0770 0.3005
dMtg         1   0.003 0.00316  0.0068 0.9346
Residuals  215 100.703 0.46839

 Response dept17 :
            Df Sum Sq Mean Sq F value Pr(>F)
female       1  0.022 0.02204  0.0531 0.8180
dMtg         1  0.073 0.07331  0.1765 0.6748
Residuals  215 89.285 0.41528

 Response inst17 :
            Df Sum Sq Mean Sq F value Pr(>F)
female       1  1.006 1.00646  2.7800 0.0969 .
dMtg         1  0.001 0.00079  0.0022 0.9627
Residuals  215 77.837 0.36203
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

 Response avg17 :
            Df Sum Sq  Mean Sq F value Pr(>F)
female       1  0.074 0.073839  0.3548 0.5521
dMtg         1  0.046 0.046459  0.2232 0.6371
Residuals  215 44.750 0.208140
```

Appendix Q3

See models in log files

```
> summary(proposal_model)

Call:
glm(formula = proposal ~ rasunit + female + white + asian + yos +
    chair + tenuretrack + doctortype, family = "binomial", data = modeldata)

Deviance Residuals:
     Min        1Q    Median        3Q       Max
-2.54801   0.00019   0.36835   0.55124   1.24418

Coefficients:
                                        Estimate Std. Error z value Pr(>|z|)
(Intercept)                              3.50373    1.59604   2.195   0.0281 *
rasunitBasic Science                     0.38628    1.25790   0.307   0.7588
rasunitCAPS                             -2.17548    0.93314  -2.331   0.0197 *
rasunitCancer and Imaging               -0.50159    0.75081  -0.668   0.5041
rasunitDept of Medicine                  0.21102    0.77264   0.273   0.7848
rasunitHospital and Speciality Services 16.39114 1495.14802   0.011   0.9913
rasunitPediatrics                        0.59538    0.98821   0.602   0.5469
rasunitPublic Health and Nursing        -0.18364    1.05253  -0.174   0.8615
rasunitYerkes                           15.85809 2349.22038   0.007   0.9946
femaleFemale                            -0.19431    0.55283  -0.351   0.7252
whiteWhite                              -0.99507    1.11752  -0.890   0.3732
asianAsian                              -1.08173    1.24547  -0.869   0.3851
yos                                     -0.03121    0.02784  -1.121   0.2623
chairChair                              -1.23102    0.82008  -1.501   0.1333
tenuretrackTenure Track                  0.75440    0.54942   1.373   0.1697
doctortypePh. D.                         0.73366    1.04570   0.702   0.4829
doctortypeM.D.                          -0.49266    1.01658  -0.485   0.6279
doctortypeM.D., Ph. D.                  16.15818 1752.76275   0.009   0.9926
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

(Dispersion parameter for binomial family taken to be 1)

    Null deviance: 159.34  on 217  degrees of freedom
Residual deviance: 131.73  on 200  degrees of freedom
AIC: 167.73

Number of Fisher Scoring iterations: 17
```

```
> summary(awards_model)

Call:
glm(formula = awardnum ~ rasunit + female + white + asian + yos +
    chair + tenuretrack + doctortype, data = modeldata)

Deviance Residuals:
    Min       1Q   Median       3Q      Max
-5.9415  -1.7020  -0.6112   0.7413  25.6274

Coefficients:
                                        Estimate Std. Error t value Pr(>|t|)
(Intercept)                              0.38971    1.48756   0.262   0.7936
rasunitBasic Science                     1.49807    0.96820   1.547   0.1234
rasunitCAPS                              0.15093    1.04613   0.144   0.8854
rasunitCancer and Imaging                1.03855    0.81440   1.275   0.2037
rasunitDept of Medicine                  3.30110    0.82439   4.004 8.78e-05 ***
rasunitHospital and Speciality Services  0.97925    1.00785   0.972   0.3324
rasunitPediatrics                        0.08039    0.94626   0.085   0.9324
rasunitPublic Health and Nursing         0.87018    0.93087   0.935   0.3510
rasunitYerkes                            1.82072    1.40501   1.296   0.1965
femaleFemale                            -0.38393    0.53455  -0.718   0.4735
whiteWhite                              -1.40214    0.85771  -1.635   0.1037
asianAsian                              -1.73168    1.02232  -1.694   0.0919 .
yos                                      0.04066    0.02742   1.483   0.1397
chairChair                              -0.21378    1.01041  -0.212   0.8327
tenuretrackTenure Track                  0.13290    0.54048   0.246   0.8060
doctortypePh. D.                         1.24817    1.12290   1.112   0.2677
doctortypeM.D.                           2.45550    1.13246   2.168   0.0313 *
doctortypeM.D., Ph. D.                   2.36442    1.42665   1.657   0.0990 .
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

(Dispersion parameter for gaussian family taken to be 11.00371)

    Null deviance: 2661.0  on 216  degrees of freedom
Residual deviance: 2189.7  on 199  degrees of freedom
  (1 observation deleted due to missingness)
AIC: 1155.4

Number of Fisher Scoring iterations: 2
```

```
> summary(tot_proposals_model)

Call:
glm(formula = proposaltotal ~ rasunit + female + white + asian +
    yos + chair + tenuretrack + doctortype, data = modeldata,
    subset = proposal == "Submitted Proposals")

Deviance Residuals:
    Min       1Q   Median       3Q      Max
-3.8007  -0.6529  -0.1368   0.3317   8.5289

Coefficients:
                                        Estimate Std. Error t value Pr(>|t|)
(Intercept)                            -0.078407   0.655925  -0.120  0.90499
rasunitBasic Science                    0.397766   0.420020   0.947  0.34495
rasunitCAPS                            -0.342056   0.506138  -0.676  0.50006
rasunitCancer and Imaging              -0.173203   0.371370  -0.466  0.64152
rasunitDept of Medicine                 1.139948   0.372872   3.057  0.00259 **
rasunitHospital and Speciality Services 0.461068   0.429823   1.073  0.28490
rasunitPediatrics                       0.310474   0.413647   0.751  0.45393
rasunitPublic Health and Nursing       -0.067282   0.403861  -0.167  0.86788
rasunitYerkes                           3.400339   0.588750   5.776 3.49e-08 ***
femaleFemale                           -0.334190   0.234822  -1.423  0.15649
whiteWhite                              0.021439   0.369364   0.058  0.95378
asianAsian                              0.360692   0.442100   0.816  0.41570
yos                                     0.006922   0.012541   0.552  0.58166
chairChair                              1.101145   0.491596   2.240  0.02637 *
tenuretrackTenure Track                 0.555177   0.244540   2.270  0.02442 *
doctortypePh. D.                        0.330909   0.523815   0.632  0.52840
doctortypeM.D.                         -0.177228   0.515745  -0.344  0.73154
doctortypeM.D., Ph. D.                  1.566858   0.625021   2.507  0.01310 *
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

(Dispersion parameter for gaussian family taken to be 1.890469)

    Null deviance: 507.30  on 190  degrees of freedom
Residual deviance: 327.05  on 173  degrees of freedom
  (1 observation deleted due to missingness)
AIC: 682.76

Number of Fisher Scoring iterations: 2
```

```
> summary(awards_model)

Call:
glm(formula = awardnum ~ rasunit + female + white + asian + yos +
    chair + tenuretrack + doctortype, data = modeldata)

Deviance Residuals:
    Min       1Q   Median       3Q      Max
-5.9415  -1.7020  -0.6112   0.7413  25.6274

Coefficients:
                                        Estimate Std. Error t value Pr(>|t|)
(Intercept)                              0.38971    1.48756   0.262   0.7936
rasunitBasic Science                     1.49807    0.96820   1.547   0.1234
rasunitCAPS                              0.15093    1.04613   0.144   0.8854
rasunitCancer and Imaging                1.03855    0.81440   1.275   0.2037
rasunitDept of Medicine                  3.30110    0.82439   4.004 8.78e-05 ***
rasunitHospital and Speciality Services  0.97925    1.00785   0.972   0.3324
rasunitPediatrics                        0.08039    0.94626   0.085   0.9324
rasunitPublic Health and Nursing         0.87018    0.93087   0.935   0.3510
rasunitYerkes                            1.82072    1.40501   1.296   0.1965
femaleFemale                            -0.38393    0.53455  -0.718   0.4735
whiteWhite                              -1.40214    0.85771  -1.635   0.1037
asianAsian                              -1.73168    1.02232  -1.694   0.0919 .
yos                                      0.04066    0.02742   1.483   0.1397
chairChair                              -0.21378    1.01041  -0.212   0.8327
tenuretrackTenure Track                  0.13290    0.54048   0.246   0.8060
doctortypePh. D.                         1.24817    1.12290   1.112   0.2677
doctortypeM.D.                           2.45550    1.13246   2.168   0.0313 *
doctortypeM.D., Ph. D.                   2.36442    1.42665   1.657   0.0990 .
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

(Dispersion parameter for gaussian family taken to be 11.00371)

    Null deviance: 2661.0  on 216  degrees of freedom
Residual deviance: 2189.7  on 199  degrees of freedom
  (1 observation deleted due to missingness)
AIC: 1155.4

Number of Fisher Scoring iterations: 2
```

Appendix - Log Files

```
> ## Levent Kayın - HR Analytics Final
>
> setwd("/Users/leventkayin/Desktop/School/HR Analytics/Final/")
>
> finaldata = read.csv2("FINALdata.csv", sep = ",")
> str(finaldata)
'data.frame':  218 obs. of  27 variables:
 $ id           : int  1 2 3 4 5 6 7 8 9 10 ...
 $ preaward17   : int  1 1 2 3 2 1 1 2 1 1 ...
 $ postaward17  : int  1 2 2 1 2 2 1 2 1 1 ...
 $ dept17       : int  2 1 2 1 1 2 1 2 1 3 ...
 $ inst17       : int  1 2 2 1 1 1 1 1 1 1 ...
 $ preaward18   : int  3 2 3 1 2 2 1 3 2 2 ...
 $ postaward18  : int  3 1 2 3 3 1 3 3 3 3 ...
 $ dept18       : int  3 2 2 3 2 2 3 3 2 3 ...
 $ inst18       : int  3 2 2 3 2 1 2 3 2 2 ...
 $ chair        : int  0 0 0 0 0 0 0 0 0 0 ...
 $ rasunit      : int  2 3 5 4 7 7 1 5 9 1 ...
 $ awardnum     : int  3 4 7 0 5 1 6 31 2 1 ...
 $ awardtotal   : Factor w/ 184 levels "","0","0.00089",..: 156 109 181 2 39 7 47 147 168
142 ...
 $ award        : int  1 1 1 0 1 1 1 1 1 1 ...
 $ proposalnum  : int  2 6 8 1 4 0 1 13 3 5 ...
 $ proposaltotal: Factor w/ 189 levels "","0","0.0058",..: 118 127 184 94 37 2 2 137 178
159 ...
 $ proposal     : int  1 1 1 1 1 0 1 1 1 1 ...
 $ doctortype   : int  2 1 2 2 2 2 2 2 1 3 ...
 $ age          : Factor w/ 164 levels "37.4","37.5",..: 93 139 97 68 40 152 39 85 47 16 ...
 $ female       : int  1 0 0 0 0 0 0 1 0 0 ...
 $ ethnicgrp    : int  3 0 0 0 0 0 0 0 0 0 ...
 $ white        : int  0 1 1 1 1 1 1 1 1 1 ...
 $ asian        : int  1 0 0 0 0 0 0 0 0 0 ...
 $ yos          : Factor w/ 142 levels "0.1","0.9","10",..: 48 104 102 21 13 113 26 66 55
8 ...
 $ nMtg         : int  1 0 3 0 0 0 0 3 0 0 ...
 $ dMtg         : int  1 0 1 0 0 0 0 1 0 0 ...
 $ tenuretrack  : int  0 1 1 1 0 0 0 0 1 1 ...
>
> dataprep = function(df) {
+
+   x2 = subset(df, df$dMtg == "No Engagement")
+   x1 = subset(df, df$dMtg == "Engagement")
+
+   f1 = data.frame(year = c(17,18),margmean = c(mean(x1$dept17),mean(x1$dept18)),stddev =
c(sd(x1$dept17),sd(x1$dept18)),type ="dept",dMtg = "Engagement")
+   f2 = data.frame(year = c(17,18),margmean =
c(mean(x1$preaward17),mean(x1$preaward18)),stddev =
c(sd(x1$preaward17),sd(x1$preaward18)),type ="preaward",dMtg = "Engagement")
+   f3 = data.frame(year = c(17,18),margmean =
c(mean(x1$postaward17),mean(x1$postaward18)),stddev =
c(sd(x1$postaward17),sd(x1$postaward18)),type ="postaward",dMtg = "Engagement")
+   f4 = data.frame(year = c(17,18),margmean = c(mean(x1$inst17),mean(x1$inst18)),stddev =
c(sd(x1$inst17),sd(x1$inst18)),type ="inst",dMtg = "Engagement")
+
+   f5 = data.frame(year = c(17,18),margmean = c(mean(x2$dept17),mean(x2$dept18)),stddev =
c(sd(x2$dept17),sd(x2$dept18)),type ="dept",dMtg = "No Engagement")
```

```
+   f6 = data.frame(year = c(17,18),margmean =
c(mean(x2$preaward17),mean(x2$preaward18)),stddev =
c(sd(x2$preaward17),sd(x2$preaward18)),type ="preaward",dMtg = "No Engagement")
+   f7 = data.frame(year = c(17,18),margmean =
c(mean(x2$postaward17),mean(x2$postaward18)),stddev =
c(sd(x2$postaward17),sd(x2$postaward18)),type ="postaward",dMtg = "No Engagement")
+   f8 = data.frame(year = c(17,18),margmean = c(mean(x2$inst17),mean(x2$inst18)),stddev =
c(sd(x2$inst17),sd(x2$inst18)),type ="inst",dMtg = "No Engagement")
+
+
+   f9 = data.frame(year = c(17,18),margmean = c(mean(x1$avg17),mean(x1$avg18)),stddev =
c(sd(x1$avg17),sd(x1$avg18)),type ="average",dMtg = "Engagement")
+   f10 = data.frame(year = c(17,18),margmean = c(mean(x2$avg17),mean(x2$avg18)),stddev =
c(sd(x2$avg17),sd(x2$avg18)),type ="average",dMtg = "No Engagement")
+
+   endframe= rbind(f1,f2,f3,f4,f9,f5,f6,f7,f8,f10)
+
+   return(endframe)
+ }
>
> ### Data manipulation - Setting variables in correct formats for modeling ----
> library(plyr)
>
> finaldata$avg17 = apply(finaldata[,c(2:5)],1,mean)
> finaldata$avg18 = apply(finaldata[,c(6:9)],1,mean)
>
> finaldata$delt_dept = finaldata$dept18-finaldata$dept17
> finaldata$delt_preaward = finaldata$preaward18-finaldata$preaward17
> finaldata$delt_postaward = finaldata$postaward18-finaldata$postaward17
> finaldata$delt_inst = finaldata$inst18-finaldata$inst17
>
> finaldata$awardtotal = as.numeric(as.character(finaldata$awardtotal))
> finaldata$proposaltotal = as.numeric(as.character(finaldata$proposaltotal))
> finaldata$age = as.numeric(as.character(finaldata$age))
> finaldata$yos = as.numeric(as.character(finaldata$yos))
>
> finaldata$chair = revalue(as.factor(finaldata$chair),c("0" = "Not Chair","1" = "Chair"))
>
> finaldata$rasunit = revalue(as.factor(finaldata$rasunit),c("1" = "ABOSS",
+                                                            "2" = "Basic Science",
+                                                            "3" = "CAPS",
+                                                            "4" = "Cancer and Imaging",
+                                                            "5" = "Dept of Medicine",
+                                                            "6" = "Hospital and Speciality
Services",
+                                                            "7" = "Pediatrics",
+                                                            "8" = "Public Health and Nursing",
+                                                            "9" = "Yerkes"))
>
> finaldata$award = revalue(as.factor(finaldata$award),c("0" = "No Awards","1" = "Recieved
Awards"))
>
> finaldata$proposal = revalue(as.factor(finaldata$proposal),c("0" = "No Submitted
Proposals","1" = "Submitted Proposals"))
>
> finaldata$doctortype = revalue(as.factor(finaldata$doctortype),c("0" = "No Doctorate",
+                                                                  "1" = "Ph. D.",
+                                                                  "2" = "M.D.",
+                                                                  "3" = "M.D., Ph. D."))
```

```
>
> finaldata$female = revalue(as.factor(finaldata$female),c("0" = "Male","1" = "Female"))
>
> finaldata$ethnicgrp = revalue(as.factor(finaldata$ethnicgrp),c("0" = "White",
+                                                                "1" = "Black",
+                                                                "2" = "Hispanic",
+                                                                "3" = "Asian",
+                                                                "4" = "American Indian"))
>
> finaldata$white = revalue(as.factor(finaldata$white),c("0" = "Not White","1" = "White"))
>
> finaldata$asian = revalue(as.factor(finaldata$asian),c("0" = "Not Asian","1" = "Asian"))
>
> finaldata$dMtg = revalue(as.factor(finaldata$dMtg),c("0" = "No Engagement","1" =
"Engagement"))
>
> finaldata$tenuretrack = revalue(as.factor(finaldata$tenuretrack),c("0" = "No Tenure","1" =
"Tenure Track"))
>
> str(finaldata)
'data.frame':  218 obs. of  33 variables:
 $ id            : int  1 2 3 4 5 6 7 8 9 10 ...
 $ preaward17    : int  1 1 2 3 2 1 1 2 1 1 ...
 $ postaward17   : int  1 2 2 1 2 2 1 2 1 1 ...
 $ dept17        : int  2 1 2 1 1 2 1 2 1 3 ...
 $ inst17        : int  1 2 2 1 1 1 1 1 1 1 ...
 $ preaward18    : int  3 2 3 1 2 2 1 3 2 2 ...
 $ postaward18   : int  3 1 2 3 3 1 3 3 3 3 ...
 $ dept18        : int  3 2 2 3 2 2 3 3 2 3 ...
 $ inst18        : int  3 2 2 3 2 1 2 3 2 2 ...
 $ chair         : Factor w/ 2 levels "Not Chair","Chair": 1 1 1 1 1 1 1 1 1 1 ...
 $ rasunit       : Factor w/ 9 levels "ABOSS","Basic Science",..: 2 3 5 4 7 7 1 5 9 1 ...
 $ awardnum      : int  3 4 7 0 5 1 6 31 2 1 ...
 $ awardtotal    : num  1.0213 0.3571 3.8195 0 0.0581 ...
 $ award         : Factor w/ 2 levels "No Awards","Recieved Awards": 2 2 2 1 2 2 2 2 2 2 ...
 $ proposalnum   : int  2 6 8 1 4 0 1 13 3 5 ...
 $ proposaltotal : num  0.68 0.896 4.087 0.41 0.102 ...
 $ proposal      : Factor w/ 2 levels "No Submitted Proposals",..: 2 2 2 2 2 1 2 2 2 2 ...
 $ doctortype    : Factor w/ 4 levels "No Doctorate",..: 3 2 3 3 3 3 3 3 2 4 ...
 $ age           : num  59.4 68.4 60 55.2 48.9 71.4 48.8 58 50.1 42.2 ...
 $ female        : Factor w/ 2 levels "Male","Female": 2 1 1 1 1 1 1 2 1 1 ...
 $ ethnicgrp     : Factor w/ 5 levels "White","Black",..: 4 1 1 1 1 1 1 1 1 1 ...
 $ white         : Factor w/ 2 levels "Not White","White": 1 2 2 2 2 2 2 2 2 2 ...
 $ asian         : Factor w/ 2 levels "Not Asian","Asian": 2 1 1 1 1 1 1 1 1 1 ...
 $ yos           : num  21.5 33.9 33 16.9 14 38 18 24.9 22.9 12.1 ...
 $ nMtg          : int  1 0 3 0 0 0 0 3 0 0 ...
 $ dMtg          : Factor w/ 2 levels "No Engagement",..: 2 1 2 1 1 1 1 2 1 1 ...
 $ tenuretrack   : Factor w/ 2 levels "No Tenure","Tenure Track": 1 2 2 2 1 1 1 1 2 2 ...
 $ avg17         : num  1.25 1.5 2 1.5 1.5 1.5 1 1.75 1 1.5 ...
 $ avg18         : num  3 1.75 2.25 2.5 2.25 1.5 2.25 3 2.25 2.5 ...
 $ delt_dept     : int  1 1 0 2 1 0 2 1 1 0 ...
 $ delt_preaward : int  2 1 1 -2 0 1 0 1 1 1 ...
 $ delt_postaward: int  2 -1 0 2 1 -1 2 1 2 2 ...
 $ delt_inst     : int  2 0 0 2 1 0 1 2 1 1 ...
> colnames(finaldata)
 [1] "id"             "preaward17"     "postaward17"    "dept17"         "inst17"
 [6] "preaward18"     "postaward18"    "dept18"         "inst18"         "chair"
[11] "rasunit"        "awardnum"       "awardtotal"     "award"          "proposalnum"
[16] "proposaltotal"  "proposal"       "doctortype"     "age"            "female"
```

```
[21] "ethnicgrp"      "white"          "asian"          "yos"            "nMtg"
[26] "dMtg"           "tenuretrack"    "avg17"          "avg18"          "delt_dept"
[31] "delt_preaward"  "delt_postaward" "delt_inst"
>
> modeldata = finaldata
>
> modeldata$preaward17 = factor(modeldata$preaward17,ordered = TRUE)
> modeldata$postaward17 = factor(modeldata$postaward17,ordered = TRUE)
> modeldata$dept17 = factor(modeldata$dept17,ordered = TRUE)
> modeldata$inst17 = factor(modeldata$inst17,ordered = TRUE)
>
> modeldata$preaward18 = factor(modeldata$preaward18,ordered = TRUE)
> modeldata$postaward18 = factor(modeldata$postaward18,ordered = TRUE)
> modeldata$dept18 = factor(modeldata$dept18,ordered = TRUE)
> modeldata$inst18 = factor(modeldata$inst18,ordered = TRUE)
>
> modeldata$delt_dept = factor(modeldata$delt_dept,ordered = TRUE)
> modeldata$delt_preaward = factor(modeldata$delt_preaward,ordered = TRUE)
> modeldata$delt_postaward = factor(modeldata$delt_postaward,ordered = TRUE)
> modeldata$delt_inst = factor(modeldata$delt_inst,ordered = TRUE)
> modeldata$delt_avg = factor(round(modeldata$avg18-modeldata$avg17),ordered = TRUE)
>
> str(modeldata)
'data.frame':  218 obs. of  34 variables:
 $ id            : int  1 2 3 4 5 6 7 8 9 10 ...
 $ preaward17    : Ord.factor w/ 3 levels "1"<"2"<"3": 1 1 2 3 2 1 1 2 1 1 ...
 $ postaward17   : Ord.factor w/ 3 levels "1"<"2"<"3": 1 2 2 1 2 2 1 2 1 1 ...
 $ dept17        : Ord.factor w/ 3 levels "1"<"2"<"3": 2 1 2 1 1 2 1 2 1 3 ...
 $ inst17        : Ord.factor w/ 3 levels "1"<"2"<"3": 1 2 2 1 1 1 1 1 1 1 ...
 $ preaward18    : Ord.factor w/ 3 levels "1"<"2"<"3": 3 2 3 1 2 2 1 3 2 2 ...
 $ postaward18   : Ord.factor w/ 3 levels "1"<"2"<"3": 3 1 2 3 3 1 3 3 3 3 ...
 $ dept18        : Ord.factor w/ 3 levels "1"<"2"<"3": 3 2 2 3 2 2 3 3 2 3 ...
 $ inst18        : Ord.factor w/ 3 levels "1"<"2"<"3": 3 2 2 3 2 1 2 3 2 2 ...
 $ chair         : Factor w/ 2 levels "Not Chair","Chair": 1 1 1 1 1 1 1 1 1 1 ...
 $ rasunit       : Factor w/ 9 levels "ABOSS","Basic Science",..: 2 3 5 4 7 7 1 5 9 1 ...
 $ awardnum      : int  3 4 7 0 5 1 6 31 2 1 ...
 $ awardtotal    : num  1.0213 0.3571 3.8195 0 0.0581 ...
 $ award         : Factor w/ 2 levels "No Awards","Recieved Awards": 2 2 2 1 2 2 2 2 2 2 ...
 $ proposalnum   : int  2 6 8 1 4 0 1 13 3 5 ...
 $ proposaltotal : num  0.68 0.896 4.087 0.41 0.102 ...
 $ proposal      : Factor w/ 2 levels "No Submitted Proposals",..: 2 2 2 2 2 1 2 2 2 2 ...
 $ doctortype    : Factor w/ 4 levels "No Doctorate",..: 3 2 3 3 3 3 3 3 2 4 ...
 $ age           : num  59.4 68.4 60 55.2 48.9 71.4 48.8 58 50.1 42.2 ...
 $ female        : Factor w/ 2 levels "Male","Female": 2 1 1 1 1 1 1 2 1 1 ...
 $ ethnicgrp     : Factor w/ 5 levels "White","Black",..: 4 1 1 1 1 1 1 1 1 1 ...
 $ white         : Factor w/ 2 levels "Not White","White": 1 2 2 2 2 2 2 2 2 2 ...
 $ asian         : Factor w/ 2 levels "Not Asian","Asian": 2 1 1 1 1 1 1 1 1 1 ...
 $ yos           : num  21.5 33.9 33 16.9 14 38 18 24.9 22.9 12.1 ...
 $ nMtg          : int  1 0 3 0 0 0 0 3 0 0 ...
 $ dMtg          : Factor w/ 2 levels "No Engagement",..: 2 1 2 1 1 1 1 2 1 1 ...
 $ tenuretrack   : Factor w/ 2 levels "No Tenure","Tenure Track": 1 2 2 2 1 1 1 1 2 2 ...
 $ avg17         : num  1.25 1.5 2 1.5 1.5 1.5 1 1.75 1 1.5 ...
 $ avg18         : num  3 1.75 2.25 2.5 2.25 1.5 2.25 3 2.25 2.5 ...
 $ delt_dept     : Ord.factor w/ 5 levels "-2"<"-1"<"0"<..: 4 4 3 5 4 3 5 4 4 3 ...
 $ delt_preaward : Ord.factor w/ 5 levels "-2"<"-1"<"0"<..: 5 4 4 1 3 4 3 4 4 4 ...
 $ delt_postaward: Ord.factor w/ 5 levels "-2"<"-1"<"0"<..: 5 2 3 5 4 2 5 4 5 5 ...
 $ delt_inst     : Ord.factor w/ 5 levels "-2"<"-1"<"0"<..: 5 3 3 5 4 3 4 5 4 4 ...
 $ delt_avg      : Ord.factor w/ 5 levels "-2"<"-1"<"0"<..: 5 3 3 4 4 3 4 4 4 4 ...
>
```

```
>
> ### Q1 -------
>
>
> library(ggplot2)
>
> summ_alldata = dataprep(finaldata)
>
> prof_plot1 = qplot(data = summ_alldata, x = year, y =margmean,geom = c("point","line"),color
= type,ylab = "Mean Rating",
+       main = "Profile Plot for 4 margmeans",facets = .~dMtg,ylim = c(1,3))+theme_minimal()
>
> prof_plot1
> #### Q2 -----
>
> library(cowplot)
>
> ## male Female----
>
> # Plots
>
> females = subset(finaldata,finaldata$female == "Female")
>
> male   = subset(finaldata,finaldata$female == "Male")
>
> indv_gender_plot =qplot(data = finaldata, x = id,y = (avg18-avg17),col = I("darkgreen"),main
="Average rating change by employee",facets = female~.) + geom_hline(yintercept =
mean(females$avg18-females$avg17), col = "darkred")
> indv_gender_plot
>
> summ_female = dataprep(females)
>
> genderplot1 = qplot(data = summ_female, x = year, y =margmean,geom = c("point","line"),color
= type,ylab = "Mean Rating",
+                     main = "Female",facets = .~dMtg,ylim = c(1,3))+theme_minimal()
+theme(legend.position = "bottom")
>
>
> summ_male = dataprep(male)
>
> genderplot2 = qplot(data = summ_male, x = year, y =margmean,geom = c("point","line"),color =
type,ylab = "Mean Rating",
+                         main = "Male",facets = .~dMtg,ylim = c(1,3))+theme_minimal()
+theme(legend.position = "bottom")
>
> genderplots = plot_grid(genderplot1,genderplot2)
>
> genderplots
>
> # Stats
> library(emmeans)
>
> gender_emmeans17 = emmeans(glm(avg17~female+dMtg,data=modeldata),c("female","dMtg"))
> gender_emmeans18 =emmeans(glm(avg18~female+dMtg,data=modeldata),c("female","dMtg"))
> gendermanova = manova(cbind(preaward17,postaward17,dept17,inst17,avg17) ~ female + dMtg,data
= modeldata)
>
> gender_emmeans17
 female dMtg            emmean         SE  df asymp.LCL asymp.UCL
```

```
 Male   No Engagement 1.751585 0.04104856 Inf  1.671131  1.832038
 Female No Engagement 1.711060 0.05597562 Inf  1.601350  1.820770
 Male   Engagement    1.786874 0.07072037 Inf  1.648265  1.925484
 Female Engagement    1.746350 0.07671858 Inf  1.595984  1.896715

Confidence level used: 0.95
> gender_emmeans18
 female dMtg            emmean         SE  df asymp.LCL asymp.UCL
 Male   No Engagement 1.692595 0.04690930 Inf  1.600654  1.784535
 Female No Engagement 1.938289 0.06396758 Inf  1.812915  2.063664
 Male   Engagement    2.225662 0.08081753 Inf  2.067263  2.384062
 Female Engagement    2.471357 0.08767214 Inf  2.299523  2.643192

Confidence level used: 0.95
> summary.aov(gendermanova)
 Response preaward17 :
            Df Sum Sq Mean Sq F value Pr(>F)
female       1  0.229 0.22855  0.4938  0.483
dMtg         1  0.257 0.25704  0.5553  0.457
Residuals  215 99.519 0.46288

 Response postaward17 :
            Df  Sum Sq Mean Sq F value Pr(>F)
female       1   0.504 0.50444  1.0770 0.3005
dMtg         1   0.003 0.00316  0.0068 0.9346
Residuals  215 100.703 0.46839

 Response dept17 :
            Df Sum Sq Mean Sq F value Pr(>F)
female       1  0.022 0.02204  0.0531 0.8180
dMtg         1  0.073 0.07331  0.1765 0.6748
Residuals  215 89.285 0.41528

 Response inst17 :
            Df Sum Sq Mean Sq F value Pr(>F)
female       1  1.006 1.00646  2.7800 0.0969 .
dMtg         1  0.001 0.00079  0.0022 0.9627
Residuals  215 77.837 0.36203
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

 Response avg17 :
            Df Sum Sq  Mean Sq F value Pr(>F)
female       1  0.074 0.073839  0.3548 0.5521
dMtg         1  0.046 0.046459  0.2232 0.6371
Residuals  215 44.750 0.208140

> arrange(summ_female,year,dMtg,type)
   year margmean    stddev      type          dMtg
1    17 1.736842 0.5619515      dept    Engagement
2    17 1.894737 0.6578363  preaward    Engagement
3    17 1.631579 0.5972647 postaward    Engagement
4    17 1.421053 0.6069770      inst    Engagement
5    17 1.671053 0.4491708   average    Engagement
6    17 1.892857 0.6231466      dept No Engagement
7    17 1.892857 0.7052677  preaward No Engagement
8    17 1.642857 0.6722708 postaward No Engagement
9    17 1.517857 0.5390588      inst No Engagement
10   17 1.736607 0.4275183   average No Engagement
```

```
11   18 2.947368 0.2294157      dept    Engagement
12   18 2.736842 0.4524139  preaward    Engagement
13   18 2.789474 0.4188539 postaward    Engagement
14   18 2.736842 0.4524139      inst    Engagement
15   18 2.802632 0.3493938   average    Engagement
16   18 2.142857 0.5197402      dept No Engagement
17   18 1.857143 0.8186146  preaward No Engagement
18   18 1.696429 0.6854234 postaward No Engagement
19   18 1.607143 0.6789985      inst No Engagement
20   18 1.825893 0.4765397   average No Engagement
> arrange(summ_male,year,dMtg,type)
   year margmean    stddev      type          dMtg
1    17 1.965517 0.7310833      dept    Engagement
2    17 1.931034 0.7036149  preaward    Engagement
3    17 1.758621 0.7394579 postaward    Engagement
4    17 1.689655 0.7608007      inst    Engagement
5    17 1.836207 0.5640885   average    Engagement
6    17 1.798246 0.6405173      dept No Engagement
7    17 1.798246 0.6675782  preaward No Engagement
8    17 1.736842 0.6919593 postaward No Engagement
9    17 1.622807 0.5858260      inst No Engagement
10   17 1.739035 0.4404723   average No Engagement
11   18 2.275862 0.7510256      dept    Engagement
12   18 2.034483 0.7784031  preaward    Engagement
13   18 2.000000 0.7559289 postaward    Engagement
14   18 1.724138 0.7018624      inst    Engagement
15   18 2.008621 0.5994147   average    Engagement
16   18 1.956140 0.6834368      dept No Engagement
17   18 1.815789 0.6857047  preaward No Engagement
18   18 1.684211 0.7079297 postaward No Engagement
19   18 1.535088 0.6122615      inst No Engagement
20   18 1.747807 0.5082240   average No Engagement
>
> ## Tenure No Tenure ----
>
> tenure = subset(finaldata,finaldata$tenuretrack == "Tenure Track")
> notenure   = subset(finaldata,finaldata$tenuretrack == "No Tenure")
>
> summ_tenure = dataprep(tenure)
>
> tenureplot = qplot(data = summ_tenure, x = year, y =margmean,geom = c("point","line"),color
= type,ylab = "Mean Rating",
+                        main = "Tenure",facets = .~dMtg,ylim = c(1,3))+theme_minimal()
+theme(legend.position = "bottom")
>
> summ_notenure = dataprep(male)
>
> notenureplot = qplot(data = summ_notenure, x = year, y =margmean,geom =
c("point","line"),color = type,ylab = "Mean Rating",
+                        main = "No Tenure",facets = .~dMtg,ylim = c(1,3))+theme_minimal()
+theme(legend.position = "bottom")
>
> tenureplots = plot_grid(tenureplot,notenureplot)
>
> tenureplots
>
> indv_tenure_plot =qplot(data = finaldata, x = id,y = (avg18-avg17),col = I("darkgreen"),main
="Average rating change by employee",facets = tenuretrack~.) + geom_hline(yintercept =
mean(females$avg18-females$avg17), col = "darkred")
```

```
> indv_tenure_plot
>
>
> # Stats
>
> tenure_emmeans17 =
emmeans(glm(avg17~tenuretrack+dMtg,data=modeldata),c("tenuretrack","dMtg"))
> tenure_emmeans18
=emmeans(glm(avg18~tenuretrack+dMtg,data=modeldata),c("tenuretrack","dMtg"))
> tenuremanova = manova(cbind(preaward17,postaward17,dept17,inst17,avg17) ~ tenuretrack +
dMtg,data = modeldata)
>
> tenure_emmeans17
 tenuretrack  dMtg            emmean         SE  df asymp.LCL asymp.UCL
 No Tenure    No Engagement 1.666353 0.04772879 Inf  1.572806  1.759900
 Tenure Track No Engagement 1.800638 0.04486001 Inf  1.712714  1.888562
 No Tenure    Engagement    1.698095 0.07316685 Inf  1.554691  1.841500
 Tenure Track Engagement    1.832381 0.07099164 Inf  1.693240  1.971522

Confidence level used: 0.95
> tenure_emmeans18
 tenuretrack  dMtg            emmean         SE  df asymp.LCL asymp.UCL
 No Tenure    No Engagement 1.904744 0.05495803 Inf  1.797028  2.012459
 Tenure Track No Engagement 1.659618 0.05165473 Inf  1.558377  1.760860
 No Tenure    Engagement    2.455693 0.08424907 Inf  2.290568  2.620818
 Tenure Track Engagement    2.210567 0.08174438 Inf  2.050351  2.370783

Confidence level used: 0.95
> summary.aov(tenuremanova)
 Response preaward17 :
             Df Sum Sq Mean Sq F value  Pr(>F)
tenuretrack   1  1.400 1.39987  3.0609 0.08162 .
dMtg          1  0.278 0.27834  0.6086 0.43617
Residuals   215 98.326 0.45733
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

 Response postaward17 :
             Df  Sum Sq Mean Sq F value Pr(>F)
tenuretrack   1   0.349 0.34886  0.7436 0.3895
dMtg          1   0.000 0.00014  0.0003 0.9862
Residuals   215 100.862 0.46913

 Response dept17 :
             Df Sum Sq Mean Sq F value Pr(>F)
tenuretrack   1  1.118 1.11789  2.7254 0.1002
dMtg          1  0.075 0.07470  0.1821 0.6700
Residuals   215 88.188 0.41018

 Response inst17 :
             Df Sum Sq Mean Sq F value  Pr(>F)
tenuretrack   1  1.272 1.27173  3.5248 0.06181 .
dMtg          1  0.001 0.00129  0.0036 0.95231
Residuals   215 77.571 0.36080
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

 Response avg17 :
             Df Sum Sq Mean Sq F value Pr(>F)
```

```
tenuretrack   1  0.980 0.97951  4.8023 0.0295 *
dMtg          1  0.038 0.03771  0.1849 0.6676
Residuals   215 43.853 0.20397
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

> arrange(summ_tenure,year,dMtg,type)
   year margmean    stddev      type          dMtg
1    17 1.846154 0.6748219      dept    Engagement
2    17 2.076923 0.6883648  preaward    Engagement
3    17 1.769231 0.7103629 postaward    Engagement
4    17 1.730769 0.7775702      inst    Engagement
5    17 1.855769 0.5795389   average    Engagement
6    17 1.923077 0.6537205      dept No Engagement
7    17 1.879121 0.6469615  preaward No Engagement
8    17 1.736264 0.7123539 postaward No Engagement
9    17 1.637363 0.6058325      inst No Engagement
10   17 1.793956 0.4558164   average No Engagement
11   18 2.230769 0.7646015      dept    Engagement
12   18 1.923077 0.7442084  preaward    Engagement
13   18 1.884615 0.7114449 postaward    Engagement
14   18 1.653846 0.6894814      inst    Engagement
15   18 1.923077 0.5646646   average    Engagement
16   18 1.956044 0.6482813      dept No Engagement
17   18 1.846154 0.7291255  preaward No Engagement
18   18 1.670330 0.7157738 postaward No Engagement
19   18 1.494505 0.5844965      inst No Engagement
20   18 1.741758 0.4851268   average No Engagement
>
> # Overall Plot
>
>
> individual_plot =qplot(data = finaldata, x = id,y = (avg18-avg17),col = I("darkgreen"),main
="Average rating change by employee",facets = tenuretrack~female) + geom_hline(yintercept =
mean(females$avg18-females$avg17), col = "darkred")
> individual_plot
>
> ### Q3 -----
>
> library(MASS)
>
> avg_model = polr(delt_avg~female+white+asian+yos+chair+tenuretrack+dMtg,data = modeldata)
> summary(avg_model)

Re-fitting to get Hessian

Call:
polr(formula = delt_avg ~ female + white + asian + yos + chair +
    tenuretrack + dMtg, data = modeldata)

Coefficients:
                          Value Std. Error t value
femaleFemale             0.71714    0.28919  2.4799
whiteWhite              -0.57262    0.48265 -1.1864
asianAsian              -0.34547    0.59383 -0.5818
yos                      0.01177    0.01531  0.7686
chairChair              -0.16218    0.58600 -0.2768
tenuretrackTenure Track -0.94921    0.30091 -3.1545
dMtgEngagement           1.24778    0.34169  3.6518
```

```
Intercepts:
      Value   Std. Error t value
-2|-1 -4.7676  0.7958    -5.9913
-1|0  -2.0987  0.5765    -3.6402
0|1    0.9496  0.5574     1.7035
1|2    2.6250  0.6006     4.3707

Residual Deviance: 468.9255
AIC: 490.9255
>
> inst_model = polr(delt_inst~female+white+asian+yos+chair+tenuretrack+dMtg,data = modeldata)
> summary(inst_model)

Re-fitting to get Hessian

Call:
polr(formula = delt_inst ~ female + white + asian + yos + chair +
    tenuretrack + dMtg, data = modeldata)

Coefficients:
                           Value Std. Error t value
femaleFemale            0.719493    0.26901  2.6746
whiteWhite             -0.488318    0.46581 -1.0483
asianAsian             -0.443075    0.56647 -0.7822
yos                     0.003177    0.01451  0.2189
chairChair             -0.726322    0.54492 -1.3329
tenuretrackTenure Track -0.785973    0.27223 -2.8872
dMtgEngagement          1.296241    0.32184  4.0276

Intercepts:
      Value   Std. Error t value
-2|-1 -3.9638  0.6485    -6.1127
-1|0  -1.3815  0.5391    -2.5626
0|1    0.4631  0.5301     0.8736
1|2    2.3200  0.5656     4.1016

Residual Deviance: 563.9684
AIC: 585.9684
>
>
> dept_model = polr(delt_dept~female+white+asian+yos+chair+tenuretrack+dMtg,data = modeldata)
> summary(dept_model)

Re-fitting to get Hessian

Call:
polr(formula = delt_dept ~ female + white + asian + yos + chair +
    tenuretrack + dMtg, data = modeldata)

Coefficients:
                           Value Std. Error t value
femaleFemale            0.35853    0.26510  1.3524
whiteWhite             -0.87971    0.46346 -1.8981
asianAsian             -0.52309    0.55281 -0.9462
yos                     0.02258    0.01486  1.5195
chairChair             -0.58012    0.58742 -0.9876
tenuretrackTenure Track -0.70046    0.27372 -2.5590
dMtgEngagement          0.98157    0.31804  3.0863
```

```
Intercepts:
      Value   Std. Error t value
-2|-1 -3.8874  0.6517    -5.9647
-1|0  -1.8905  0.5528    -3.4197
0|1    0.0951  0.5403     0.1760
1|2    1.9428  0.5645     3.4418

Residual Deviance: 570.6448
AIC: 592.6448
>
>
> preaward_model = polr(delt_preaward~female+white+asian+yos+chair+tenuretrack+dMtg,data =
modeldata)
> summary(preaward_model)

Re-fitting to get Hessian

Call:
polr(formula = delt_preaward ~ female + white + asian + yos +
    chair + tenuretrack + dMtg, data = modeldata)

Coefficients:
                           Value Std. Error t value
femaleFemale            0.130061     0.2696  0.4824
whiteWhite             -0.218447     0.4322 -0.5055
asianAsian             -0.087150     0.5193 -0.1678
yos                     0.005341     0.0140  0.3816
chairChair              0.463056     0.5579  0.8300
tenuretrackTenure Track -0.528506     0.2674 -1.9766
dMtgEngagement          0.726732     0.3093  2.3495

Intercepts:
      Value   Std. Error t value
-2|-1 -3.5929  0.6184    -5.8097
-1|0  -0.8216  0.4988    -1.6471
0|1    0.4114  0.4948     0.8316
1|2    2.3078  0.5368     4.2988

Residual Deviance: 599.7335
AIC: 621.7335
>
> postaward_model = polr(delt_postaward~female+white+asian+yos+chair+tenuretrack+dMtg,data =
modeldata)
> summary(postaward_model)

Re-fitting to get Hessian

Call:
polr(formula = delt_postaward ~ female + white + asian + yos +
    chair + tenuretrack + dMtg, data = modeldata)

Coefficients:
                           Value Std. Error t value
femaleFemale            0.492338    0.26292  1.8726
whiteWhite             -0.396902    0.43639 -0.9095
asianAsian             -0.416587    0.53378 -0.7805
yos                     0.005732    0.01436  0.3992
chairChair              0.472613    0.50165  0.9421
```

```
tenuretrackTenure Track -0.505739    0.26961 -1.8758
dMtgEngagement           1.133157    0.30863  3.6715

Intercepts:
      Value   Std. Error t value
-2|-1 -3.0382  0.5718    -5.3130
-1|0  -0.9566  0.5091    -1.8788
0|1    0.5058  0.5046     1.0023
1|2    2.2371  0.5373     4.1638

Residual Deviance: 613.4761
AIC: 635.4761
>
> ### Q4 ------
>
> proposal_model =
glm(proposal~rasunit+female+white+asian+yos+chair+tenuretrack+doctortype,data =
modeldata,family = "binomial")
Warning message:
glm.fit: fitted probabilities numerically 0 or 1 occurred
> summary(proposal_model)

Call:
glm(formula = proposal ~ rasunit + female + white + asian + yos +
    chair + tenuretrack + doctortype, family = "binomial", data = modeldata)

Deviance Residuals:
     Min        1Q    Median        3Q       Max
-2.54801   0.00019   0.36835   0.55124   1.24418

Coefficients:
                                      Estimate Std. Error z value Pr(>|z|)
(Intercept)                            3.50373    1.59604   2.195   0.0281 *
rasunitBasic Science                   0.38628    1.25790   0.307   0.7588
rasunitCAPS                           -2.17548    0.93314  -2.331   0.0197 *
rasunitCancer and Imaging             -0.50159    0.75081  -0.668   0.5041
rasunitDept of Medicine                0.21102    0.77264   0.273   0.7848
rasunitHospital and Speciality Services 16.39114 1495.14802   0.011   0.9913
rasunitPediatrics                      0.59538    0.98821   0.602   0.5469
rasunitPublic Health and Nursing      -0.18364    1.05253  -0.174   0.8615
rasunitYerkes                         15.85809 2349.22038   0.007   0.9946
femaleFemale                          -0.19431    0.55283  -0.351   0.7252
whiteWhite                            -0.99507    1.11752  -0.890   0.3732
asianAsian                            -1.08173    1.24547  -0.869   0.3851
yos                                   -0.03121    0.02784  -1.121   0.2623
chairChair                            -1.23102    0.82008  -1.501   0.1333
tenuretrackTenure Track                0.75440    0.54942   1.373   0.1697
doctortypePh. D.                       0.73366    1.04570   0.702   0.4829
doctortypeM.D.                        -0.49266    1.01658  -0.485   0.6279
doctortypeM.D., Ph. D.                16.15818 1752.76275   0.009   0.9926
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

(Dispersion parameter for binomial family taken to be 1)

    Null deviance: 159.34  on 217  degrees of freedom
Residual deviance: 131.73  on 200  degrees of freedom
AIC: 167.73
```

```
Number of Fisher Scoring iterations: 17

>
> awards_model = glm(awardnum~rasunit+female+white+asian+yos+chair+tenuretrack+doctortype,data
= modeldata)
> summary(awards_model)

Call:
glm(formula = awardnum ~ rasunit + female + white + asian + yos +
    chair + tenuretrack + doctortype, data = modeldata)

Deviance Residuals:
    Min       1Q   Median       3Q      Max
-5.9415  -1.7020  -0.6112   0.7413  25.6274

Coefficients:
                                   Estimate Std. Error t value Pr(>|t|)
(Intercept)                         0.38971    1.48756   0.262   0.7936
rasunitBasic Science                1.49807    0.96820   1.547   0.1234
rasunitCAPS                         0.15093    1.04613   0.144   0.8854
rasunitCancer and Imaging           1.03855    0.81440   1.275   0.2037
rasunitDept of Medicine             3.30110    0.82439   4.004 8.78e-05 ***
rasunitHospital and Speciality Services  0.97925    1.00785   0.972   0.3324
rasunitPediatrics                   0.08039    0.94626   0.085   0.9324
rasunitPublic Health and Nursing    0.87018    0.93087   0.935   0.3510
rasunitYerkes                       1.82072    1.40501   1.296   0.1965
femaleFemale                       -0.38393    0.53455  -0.718   0.4735
whiteWhite                         -1.40214    0.85771  -1.635   0.1037
asianAsian                         -1.73168    1.02232  -1.694   0.0919 .
yos                                 0.04066    0.02742   1.483   0.1397
chairChair                         -0.21378    1.01041  -0.212   0.8327
tenuretrackTenure Track             0.13290    0.54048   0.246   0.8060
doctortypePh. D.                    1.24817    1.12290   1.112   0.2677
doctortypeM.D.                      2.45550    1.13246   2.168   0.0313 *
doctortypeM.D., Ph. D.              2.36442    1.42665   1.657   0.0990 .
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

(Dispersion parameter for gaussian family taken to be 11.00371)

    Null deviance: 2661.0  on 216  degrees of freedom
Residual deviance: 2189.7  on 199  degrees of freedom
  (1 observation deleted due to missingness)
AIC: 1155.4

Number of Fisher Scoring iterations: 2

>
> tot_proposals_model =
glm(proposaltotal~rasunit+female+white+asian+yos+chair+tenuretrack+doctortype,data =
modeldata,subset = proposal =="Submitted Proposals")
> summary(tot_proposals_model)

Call:
glm(formula = proposaltotal ~ rasunit + female + white + asian +
    yos + chair + tenuretrack + doctortype, data = modeldata,
    subset = proposal == "Submitted Proposals")

Deviance Residuals:
```

```
    Min       1Q   Median       3Q      Max
-3.8007  -0.6529  -0.1368   0.3317   8.5289

Coefficients:
                                      Estimate Std. Error t value Pr(>|t|)
(Intercept)                          -0.078407   0.655925  -0.120  0.90499
rasunitBasic Science                  0.397766   0.420020   0.947  0.34495
rasunitCAPS                          -0.342056   0.506138  -0.676  0.50006
rasunitCancer and Imaging            -0.173203   0.371370  -0.466  0.64152
rasunitDept of Medicine               1.139948   0.372872   3.057  0.00259 **
rasunitHospital and Speciality Services  0.461068   0.429823   1.073  0.28490
rasunitPediatrics                     0.310474   0.413647   0.751  0.45393
rasunitPublic Health and Nursing     -0.067282   0.403861  -0.167  0.86788
rasunitYerkes                         3.400339   0.588750   5.776 3.49e-08 ***
femaleFemale                         -0.334190   0.234822  -1.423  0.15649
whiteWhite                            0.021439   0.369364   0.058  0.95378
asianAsian                            0.360692   0.442100   0.816  0.41570
yos                                   0.006922   0.012541   0.552  0.58166
chairChair                            1.101145   0.491596   2.240  0.02637 *
tenuretrackTenure Track               0.555177   0.244540   2.270  0.02442 *
doctortypePh. D.                      0.330909   0.523815   0.632  0.52840
doctortypeM.D.                       -0.177228   0.515745  -0.344  0.73154
doctortypeM.D., Ph. D.                1.566858   0.625021   2.507  0.01310 *
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

(Dispersion parameter for gaussian family taken to be 1.890469)

    Null deviance: 507.30  on 190  degrees of freedom
Residual deviance: 327.05  on 173  degrees of freedom
  (1 observation deleted due to missingness)
AIC: 682.76

Number of Fisher Scoring iterations: 2

>
> tot_awards_model =
glm(awardtotal~rasunit+female+white+asian+yos+chair+tenuretrack+doctortype,data = modeldata)
> summary(awards_model)

Call:
glm(formula = awardnum ~ rasunit + female + white + asian + yos +
    chair + tenuretrack + doctortype, data = modeldata)

Deviance Residuals:
    Min       1Q   Median       3Q      Max
-5.9415  -1.7020  -0.6112   0.7413  25.6274

Coefficients:
                                     Estimate Std. Error t value Pr(>|t|)
(Intercept)                           0.38971    1.48756   0.262   0.7936
rasunitBasic Science                  1.49807    0.96820   1.547   0.1234
rasunitCAPS                           0.15093    1.04613   0.144   0.8854
rasunitCancer and Imaging             1.03855    0.81440   1.275   0.2037
rasunitDept of Medicine               3.30110    0.82439   4.004 8.78e-05 ***
rasunitHospital and Speciality Services  0.97925    1.00785   0.972   0.3324
rasunitPediatrics                     0.08039    0.94626   0.085   0.9324
rasunitPublic Health and Nursing      0.87018    0.93087   0.935   0.3510
rasunitYerkes                         1.82072    1.40501   1.296   0.1965
```

```
femaleFemale                            -0.38393    0.53455  -0.718   0.4735
whiteWhite                              -1.40214    0.85771  -1.635   0.1037
asianAsian                              -1.73168    1.02232  -1.694   0.0919 .
yos                                      0.04066    0.02742   1.483   0.1397
chairChair                              -0.21378    1.01041  -0.212   0.8327
tenuretrackTenure Track                  0.13290    0.54048   0.246   0.8060
doctortypePh. D.                         1.24817    1.12290   1.112   0.2677
doctortypeM.D.                           2.45550    1.13246   2.168   0.0313 *
doctortypeM.D., Ph. D.                   2.36442    1.42665   1.657   0.0990 .
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

(Dispersion parameter for gaussian family taken to be 11.00371)

    Null deviance: 2661.0  on 216  degrees of freedom
Residual deviance: 2189.7  on 199  degrees of freedom
  (1 observation deleted due to missingness)
AIC: 1155.4

Number of Fisher Scoring iterations: 2
```