A02g CRT Correlations (P101 Final exam - Jan, 2018)

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# Overview

This is a companion report for “A02 Initial Explain Your Answee Report (P101 Final exam - Jan, 2018)”. In this report, correlations between the treatment and gender are examined in more detail. It has the same setup section as A02

# Setup

## Loading required package: Matrix

## Loading required package: xts

## Loading required package: zoo

##   
## Attaching package: 'zoo'

## The following objects are masked from 'package:base':  
##   
## as.Date, as.Date.numeric

##   
## Attaching package: 'PerformanceAnalytics'

## The following object is masked from 'package:graphics':  
##   
## legend

##   
## Attaching package: 'dplyr'

## The following objects are masked from 'package:xts':  
##   
## first, last

## The following objects are masked from 'package:plyr':  
##   
## arrange, count, desc, failwith, id, mutate, rename, summarise,  
## summarize

## The following objects are masked from 'package:stats':  
##   
## filter, lag

## The following objects are masked from 'package:base':  
##   
## intersect, setdiff, setequal, union

### Add additional calculated values

The following is a summary of the variables present in the data file. The final 4 were caculated in this notebook. “Fix” refers to removing from the overall score on the test, the score of the specific question.

names(dat.raw)

## [1] "ID" "QNUM" "QCORRECT"   
## [4] "TREATMENT" "f.Atot40" "f.Btot38"   
## [7] "f.tot78" "course.grade" "d.version"   
## [10] "f.version" "NCRT" "Gender"   
## [13] "EYAfinal" "course.grade.frac" "CRT.medsplit"   
## [16] "final.grade.LMH" "final.grade.fix" "final.gradeA.fix"   
## [19] "f.tot100" "CONTROL" "CRT.medsplit.rev"   
## [22] "GRELEVEL"

# Treatment x CRT.medsplit

In this section we compare making data subset for each level of the CRT median split with using the TREATMENT x CRT.medsplit interaction terms

### Run the regressions on the two groups individually

Low CRT data first

## Generalized linear mixed model fit by maximum likelihood (Laplace  
## Approximation) [glmerMod]  
## Family: binomial ( logit )  
## Formula: QCORRECT ~ TREATMENT + final.grade.fix + (1 | QNUM) + (1 | ID)  
## Data: subset(dat.trt, CRT.medsplit == 0)  
## Control: glmerControl(optimizer = "bobyqa")  
##   
## AIC BIC logLik deviance df.resid   
## 1206.5 1230.6 -598.2 1196.5 911   
##   
## Scaled residuals:   
## Min 1Q Median 3Q Max   
## -1.7074 -0.8922 -0.4745 0.9298 2.5137   
##   
## Random effects:  
## Groups Name Variance Std.Dev.  
## ID (Intercept) 0.0000 0.0000   
## QNUM (Intercept) 0.1834 0.4282   
## Number of obs: 916, groups: ID, 228; QNUM, 4  
##   
## Fixed effects:  
## Estimate Std. Error z value Pr(>|z|)   
## (Intercept) -1.7681 0.3423 -5.166 2.39e-07 \*\*\*  
## TREATMENT1 0.1725 0.1386 1.245 0.213   
## final.grade.fix 2.7528 0.4207 6.544 5.99e-11 \*\*\*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Correlation of Fixed Effects:  
## (Intr) TREATM  
## TREATMENT1 -0.213   
## finl.grd.fx -0.726 0.014

## Est LL UL  
## (Intercept) 0.1706497 0.08724775 0.3337772  
## TREATMENT1 1.1882996 0.90564663 1.5591688  
## final.grade.fix 15.6859338 6.87768656 35.7748958

High CRT data

## Generalized linear mixed model fit by maximum likelihood (Laplace  
## Approximation) [glmerMod]  
## Family: binomial ( logit )  
## Formula: QCORRECT ~ TREATMENT + final.grade.fix + (1 | QNUM) + (1 | ID)  
## Data: subset(dat.trt, CRT.medsplit == 1)  
## Control: glmerControl(optimizer = "bobyqa")  
##   
## AIC BIC logLik deviance df.resid   
## 1853.0 1880.1 -921.5 1843.0 1679   
##   
## Scaled residuals:   
## Min 1Q Median 3Q Max   
## -3.5670 -0.8901 0.4451 0.6209 1.9233   
##   
## Random effects:  
## Groups Name Variance Std.Dev.   
## ID (Intercept) 4.752e-17 6.893e-09  
## QNUM (Intercept) 2.084e-01 4.565e-01  
## Number of obs: 1684, groups: ID, 420; QNUM, 4  
##   
## Fixed effects:  
## Estimate Std. Error z value Pr(>|z|)   
## (Intercept) -1.9907 0.3426 -5.81 6.26e-09 \*\*\*  
## TREATMENT1 0.2860 0.1144 2.50 0.0124 \*   
## final.grade.fix 4.0380 0.3598 11.22 < 2e-16 \*\*\*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Correlation of Fixed Effects:  
## (Intr) TREATM  
## TREATMENT1 -0.178   
## finl.grd.fx -0.709 0.027

## Est LL UL  
## (Intercept) 0.1366045 0.06979153 0.2673788  
## TREATMENT1 1.3311383 1.06374968 1.6657388  
## final.grade.fix 56.7123397 28.01703628 114.7976340

CRT effect for control condition only, controlling for question difficulty and test perfromance

## Generalized linear mixed model fit by maximum likelihood (Laplace  
## Approximation) [glmerMod]  
## Family: binomial ( logit )  
## Formula: QCORRECT ~ CRT.medsplit + final.grade.fix + (1 | QNUM) + (1 |   
## ID)  
## Data: subset(dat.trt, TREATMENT == 0)  
## Control: glmerControl(optimizer = "bobyqa")  
##   
## AIC BIC logLik deviance df.resid   
## 1567.0 1592.8 -778.5 1557.0 1295   
##   
## Scaled residuals:   
## Min 1Q Median 3Q Max   
## -2.7254 -0.8776 0.4564 0.7223 2.1447   
##   
## Random effects:  
## Groups Name Variance Std.Dev.  
## ID (Intercept) 0.04938 0.2222   
## QNUM (Intercept) 0.17479 0.4181   
## Number of obs: 1300, groups: ID, 648; QNUM, 4  
##   
## Fixed effects:  
## Estimate Std. Error z value Pr(>|z|)   
## (Intercept) -2.2374 0.3309 -6.762 1.36e-11 \*\*\*  
## CRT.medsplit 0.5645 0.1343 4.205 2.61e-05 \*\*\*  
## final.grade.fix 3.5738 0.3989 8.960 < 2e-16 \*\*\*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Correlation of Fixed Effects:  
## (Intr) CRT.md  
## CRT.medsplt -0.074   
## finl.grd.fx -0.713 -0.218

## Est LL UL  
## (Intercept) 0.106731 0.05580075 0.2041461  
## CRT.medsplit 1.758644 1.35172582 2.2880583  
## final.grade.fix 35.650129 16.31314065 77.9084626

CRT effect for treatment condition only, controlling for question difficulty and test performance

## Generalized linear mixed model fit by maximum likelihood (Laplace  
## Approximation) [glmerMod]  
## Family: binomial ( logit )  
## Formula: QCORRECT ~ CRT.medsplit + final.grade.fix + (1 | QNUM) + (1 |   
## ID)  
## Data: subset(dat.trt, TREATMENT == 1)  
## Control: glmerControl(optimizer = "bobyqa")  
##   
## AIC BIC logLik deviance df.resid   
## 1523.5 1549.3 -756.7 1513.5 1295   
##   
## Scaled residuals:   
## Min 1Q Median 3Q Max   
## -2.8951 -0.9044 0.4590 0.6524 2.3367   
##   
## Random effects:  
## Groups Name Variance Std.Dev.  
## ID (Intercept) 0.09284 0.3047   
## QNUM (Intercept) 0.10412 0.3227   
## Number of obs: 1300, groups: ID, 648; QNUM, 4  
##   
## Fixed effects:  
## Estimate Std. Error z value Pr(>|z|)   
## (Intercept) -1.9880 0.3040 -6.539 6.19e-11 \*\*\*  
## CRT.medsplit 0.6950 0.1389 5.004 5.63e-07 \*\*\*  
## final.grade.fix 3.4238 0.4047 8.461 < 2e-16 \*\*\*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Correlation of Fixed Effects:  
## (Intr) CRT.md  
## CRT.medsplt -0.089   
## finl.grd.fx -0.779 -0.197

## Est LL UL  
## (Intercept) 0.136966 0.07547907 0.2485416  
## CRT.medsplit 2.003647 1.52612931 2.6305762  
## final.grade.fix 30.686604 13.88350109 67.8263811

### Run the regressions on the entire data set with TREATMENT x CRT.medsplit interaction term

First run with low CRT and TREATMENT=Control as the base levels

## Generalized linear mixed model fit by maximum likelihood (Laplace  
## Approximation) [glmerMod]  
## Family: binomial ( logit )  
## Formula: QCORRECT ~ TREATMENT \* CRT.medsplit + final.grade.fix + (1 |   
## QNUM) + (1 | ID)  
## Data: dat.trt  
## Control: glmerControl(optimizer = "bobyqa")  
##   
## AIC BIC logLik deviance df.resid   
## 3076.0 3117.1 -1531.0 3062.0 2593   
##   
## Scaled residuals:   
## Min 1Q Median 3Q Max   
## -3.1572 -0.9095 0.4642 0.6908 2.6693   
##   
## Random effects:  
## Groups Name Variance Std.Dev.  
## ID (Intercept) 0.0000 0.000   
## QNUM (Intercept) 0.1421 0.377   
## Number of obs: 2600, groups: ID, 648; QNUM, 4  
##   
## Fixed effects:  
## Estimate Std. Error z value Pr(>|z|)   
## (Intercept) -2.1747 0.2665 -8.160 3.34e-16 \*\*\*  
## TREATMENT1 0.1554 0.1397 1.112 0.266   
## CRT.medsplit 0.5615 0.1280 4.387 1.15e-05 \*\*\*  
## final.grade.fix 3.4669 0.2719 12.752 < 2e-16 \*\*\*  
## TREATMENT1:CRT.medsplit 0.1224 0.1795 0.682 0.495   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Correlation of Fixed Effects:  
## (Intr) TREATMENT1 CRT.md fnl.g.  
## TREATMENT1 -0.266   
## CRT.medsplt -0.172 0.542   
## finl.grd.fx -0.602 0.008 -0.188   
## TREATMENT1: 0.200 -0.779 -0.688 0.006

## Est LL UL  
## (Intercept) 0.1136441 0.06740656 0.1915984  
## TREATMENT1 1.1680910 0.88826229 1.5360739  
## CRT.medsplit 1.7533076 1.36431982 2.2532015  
## final.grade.fix 32.0361018 18.80297438 54.5824187  
## TREATMENT1:CRT.medsplit 1.1302342 0.79494196 1.6069466

Then run with high CRT and TREATMENT=Control as the base levels

## Generalized linear mixed model fit by maximum likelihood (Laplace  
## Approximation) [glmerMod]  
## Family: binomial ( logit )  
## Formula: QCORRECT ~ TREATMENT \* CRT.medsplit.rev + final.grade.fix + (1 |   
## QNUM) + (1 | ID)  
## Data: dat.trt  
## Control: glmerControl(optimizer = "bobyqa")  
##   
## AIC BIC logLik deviance df.resid   
## 3076.0 3117.1 -1531.0 3062.0 2593   
##   
## Scaled residuals:   
## Min 1Q Median 3Q Max   
## -3.1572 -0.9095 0.4642 0.6908 2.6693   
##   
## Random effects:  
## Groups Name Variance Std.Dev.  
## ID (Intercept) 0.0000 0.000   
## QNUM (Intercept) 0.1421 0.377   
## Number of obs: 2600, groups: ID, 648; QNUM, 4  
##   
## Fixed effects:  
## Estimate Std. Error z value Pr(>|z|)   
## (Intercept) -1.6132 0.2751 -5.864 4.51e-09 \*\*\*  
## TREATMENT1 0.2778 0.1127 2.466 0.0137 \*   
## CRT.medsplit.rev -0.5615 0.1280 -4.387 1.15e-05 \*\*\*  
## final.grade.fix 3.4669 0.2719 12.753 < 2e-16 \*\*\*  
## TREATMENT1:CRT.medsplit.rev -0.1224 0.1795 -0.682 0.4953   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Correlation of Fixed Effects:  
## (Intr) TREATMENT1 CRT.m. fnl.g.  
## TREATMENT1 -0.208   
## CRT.mdsplt. -0.299 0.423   
## finl.grd.fx -0.671 0.019 0.188   
## TREATMENT1: 0.126 -0.628 -0.688 -0.006

## Est LL UL  
## (Intercept) 0.1992535 0.1162129 0.3416313  
## TREATMENT1 1.3202159 1.0586438 1.6464180  
## CRT.medsplit.rev 0.5703502 0.4438147 0.7329622  
## final.grade.fix 32.0360576 18.8032989 54.5813258  
## TREATMENT1:CRT.medsplit.rev 0.8847727 0.6223034 1.2579438

Then run with high CRT and TREATMENT=Treatment as the base levels

## Generalized linear mixed model fit by maximum likelihood (Laplace  
## Approximation) [glmerMod]  
## Family: binomial ( logit )  
## Formula: QCORRECT ~ CONTROL \* CRT.medsplit.rev + final.grade.fix + (1 |   
## QNUM) + (1 | ID)  
## Data: dat.trt  
## Control: glmerControl(optimizer = "bobyqa")  
##   
## AIC BIC logLik deviance df.resid   
## 3076.0 3117.1 -1531.0 3062.0 2593   
##   
## Scaled residuals:   
## Min 1Q Median 3Q Max   
## -3.1572 -0.9095 0.4642 0.6908 2.6693   
##   
## Random effects:  
## Groups Name Variance Std.Dev.  
## ID (Intercept) 0.0000 0.000   
## QNUM (Intercept) 0.1421 0.377   
## Number of obs: 2600, groups: ID, 648; QNUM, 4  
##   
## Fixed effects:  
## Estimate Std. Error z value Pr(>|z|)   
## (Intercept) -1.3354 0.2747 -4.862 1.16e-06 \*\*\*  
## CONTROL1 -0.2778 0.1127 -2.466 0.0137 \*   
## CRT.medsplit.rev -0.6839 0.1305 -5.243 1.58e-07 \*\*\*  
## final.grade.fix 3.4669 0.2718 12.753 < 2e-16 \*\*\*  
## CONTROL1:CRT.medsplit.rev 0.1224 0.1795 0.682 0.4953   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Correlation of Fixed Effects:  
## (Intr) CONTROL1 CRT.m. fnl.g.  
## CONTROL1 -0.202   
## CRT.mdsplt. -0.304 0.449   
## finl.grd.fx -0.664 -0.019 0.176   
## CONTROL1:CR 0.131 -0.628 -0.702 0.006

## Est LL UL  
## (Intercept) 0.2630577 0.1535466 0.4506733  
## CONTROL1 0.7574515 0.6073793 0.9446036  
## CRT.medsplit.rev 0.5046303 0.3907792 0.6516513  
## final.grade.fix 32.0360843 18.8036529 54.5803896  
## CONTROL1:CRT.medsplit.rev 1.1302342 0.7949482 1.6069342

And then for completion run with Low CRT and TREATMENT=Treatment as the base levels

## Generalized linear mixed model fit by maximum likelihood (Laplace  
## Approximation) [glmerMod]  
## Family: binomial ( logit )  
## Formula:   
## QCORRECT ~ CONTROL \* CRT.medsplit + final.grade.fix + (1 | QNUM) +   
## (1 | ID)  
## Data: dat.trt  
## Control: glmerControl(optimizer = "bobyqa")  
##   
## AIC BIC logLik deviance df.resid   
## 3076.0 3117.1 -1531.0 3062.0 2593   
##   
## Scaled residuals:   
## Min 1Q Median 3Q Max   
## -3.1572 -0.9095 0.4642 0.6908 2.6693   
##   
## Random effects:  
## Groups Name Variance Std.Dev.   
## ID (Intercept) 1.155e-13 3.399e-07  
## QNUM (Intercept) 1.421e-01 3.770e-01  
## Number of obs: 2600, groups: ID, 648; QNUM, 4  
##   
## Fixed effects:  
## Estimate Std. Error z value Pr(>|z|)   
## (Intercept) -2.0193 0.2659 -7.594 3.10e-14 \*\*\*  
## CONTROL1 -0.1554 0.1397 -1.112 0.266   
## CRT.medsplit 0.6839 0.1305 5.243 1.58e-07 \*\*\*  
## final.grade.fix 3.4669 0.2719 12.753 < 2e-16 \*\*\*  
## CONTROL1:CRT.medsplit -0.1224 0.1795 -0.682 0.495   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Correlation of Fixed Effects:  
## (Intr) CONTROL1 CRT.md fnl.g.  
## CONTROL1 -0.259   
## CRT.medsplt -0.177 0.540   
## finl.grd.fx -0.599 -0.008 -0.176   
## CONTROL1:CR 0.209 -0.779 -0.702 -0.006

## Est LL UL  
## (Intercept) 0.1327469 0.0788279 0.2235471  
## CONTROL1 0.8560976 0.6510110 1.1257921  
## CRT.medsplit 1.9816478 1.5345611 2.5589911  
## final.grade.fix 32.0360673 18.8032207 54.5815862  
## CONTROL1:CRT.medsplit 0.8847724 0.6223010 1.2579481

### Summary of results

*Format table in markdown instead of R for fun*

None of the cross terms were statistically significant

|  |  |  |
| --- | --- | --- |
| ODDS RATIOS [95%CI] | Data Subset | Interaction Term |
| Treatment (low CRT) | 1.188 [0.906, 1.559] | 1.168 [0.888, 1.536] |
| Treatment (high CRT) | 1.331\* [1.064, 1.666] | 1.32\* [1.059, 1.646] |
| CRT split (Control) | 1.759\*\*\* [1.352, 2.288] | 1.753\*\*\* [1.364, 2.253] |
| CRT split (Treatment) | 2.004\*\*\* [1.526, 2.631] | 1.982\*\*\* [1.535, 2.559] |

# Some quick checks with NCRT instead of CRT.medsplit

## Generalized linear mixed model fit by maximum likelihood (Laplace  
## Approximation) [glmerMod]  
## Family: binomial ( logit )  
## Formula: QCORRECT ~ TREATMENT \* NCRT + final.grade.fix + (1 | QNUM) +   
## (1 | ID)  
## Data: dat.trt  
## Control: glmerControl(optimizer = "bobyqa")  
##   
## AIC BIC logLik deviance df.resid   
## 3067.7 3108.8 -1526.9 3053.7 2593   
##   
## Scaled residuals:   
## Min 1Q Median 3Q Max   
## -3.2781 -0.9067 0.4619 0.6866 2.7912   
##   
## Random effects:  
## Groups Name Variance Std.Dev.  
## ID (Intercept) 0.0000 0.0000   
## QNUM (Intercept) 0.1423 0.3772   
## Number of obs: 2600, groups: ID, 648; QNUM, 4  
##   
## Fixed effects:  
## Estimate Std. Error z value Pr(>|z|)   
## (Intercept) -2.28794 0.27208 -8.409 < 2e-16 \*\*\*  
## TREATMENT1 0.20138 0.16934 1.189 0.234   
## NCRT 0.30026 0.05823 5.157 2.51e-07 \*\*\*  
## final.grade.fix 3.33545 0.27581 12.093 < 2e-16 \*\*\*  
## TREATMENT1:NCRT 0.01663 0.08110 0.205 0.838   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Correlation of Fixed Effects:  
## (Intr) TREATMENT1 NCRT fnl.g.  
## TREATMENT1 -0.316   
## NCRT -0.247 0.590   
## finl.grd.fx -0.571 0.008 -0.214   
## TREATMENT1: 0.263 -0.855 -0.684 0.002

## Est LL UL  
## (Intercept) 0.1014756 0.05953351 0.1729665  
## TREATMENT1 1.2230911 0.87764137 1.7045138  
## NCRT 1.3502107 1.20458924 1.5134361  
## final.grade.fix 28.0909650 16.36049334 48.2321833  
## TREATMENT1:NCRT 1.0167644 0.86733496 1.1919384