Multiple Regression: Moderation and Mediation Tutorial

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2025-02-24

Load in required libraries

```
library(jmv)
library(rockchalk)
library(psych)
library(multilevel)
library(tidyverse)
```

Load data set into R-Environment

```
dat<-read.csv("DemoMod.csv")
dat2<-read.csv("DemoMed.csv")
```

Moderation Tutorial Markdown

We are going to use `dat` for a tutorial of moderation analyses. This data set consists of performance evaluation review data (`perf_eval`) for employees of a Marketing Firm. Additionally, we have data for the employee's original interview rating (`interview`), their age at hire (`age`), dichotomous coded sex (`gender` : 0 = Males; 1 = Females), and polytomous race (`race` : 1 = Caucasian, 2 = African-American, 3 = Asian).

Applied prompt: Our boss wants to know if the association between performance evaluation and interview ratings is moderated by the demographic variables of age and gender. We will treat performance evaluation as the criterion variable for this tutorial.

Recode Predictors and Moderators (Centering and Dummy Coding)

```
# Center all predictors/moderators that are continuous
dat$interviewC <- dat$interview - mean(dat$interview)
dat$ageC <- dat$age - mean(dat$age)

# Dummy code all categorical variables NOT already coded 0 and 1
AA_dc <- dummy.code(dat$race, group = 2)
As_dc <- dummy.code(dat$race, group = 3)
dat <- data.frame(dat, AA_dc, As_dc)
```

Calculate Descriptive Statistics and Correlation Matrix

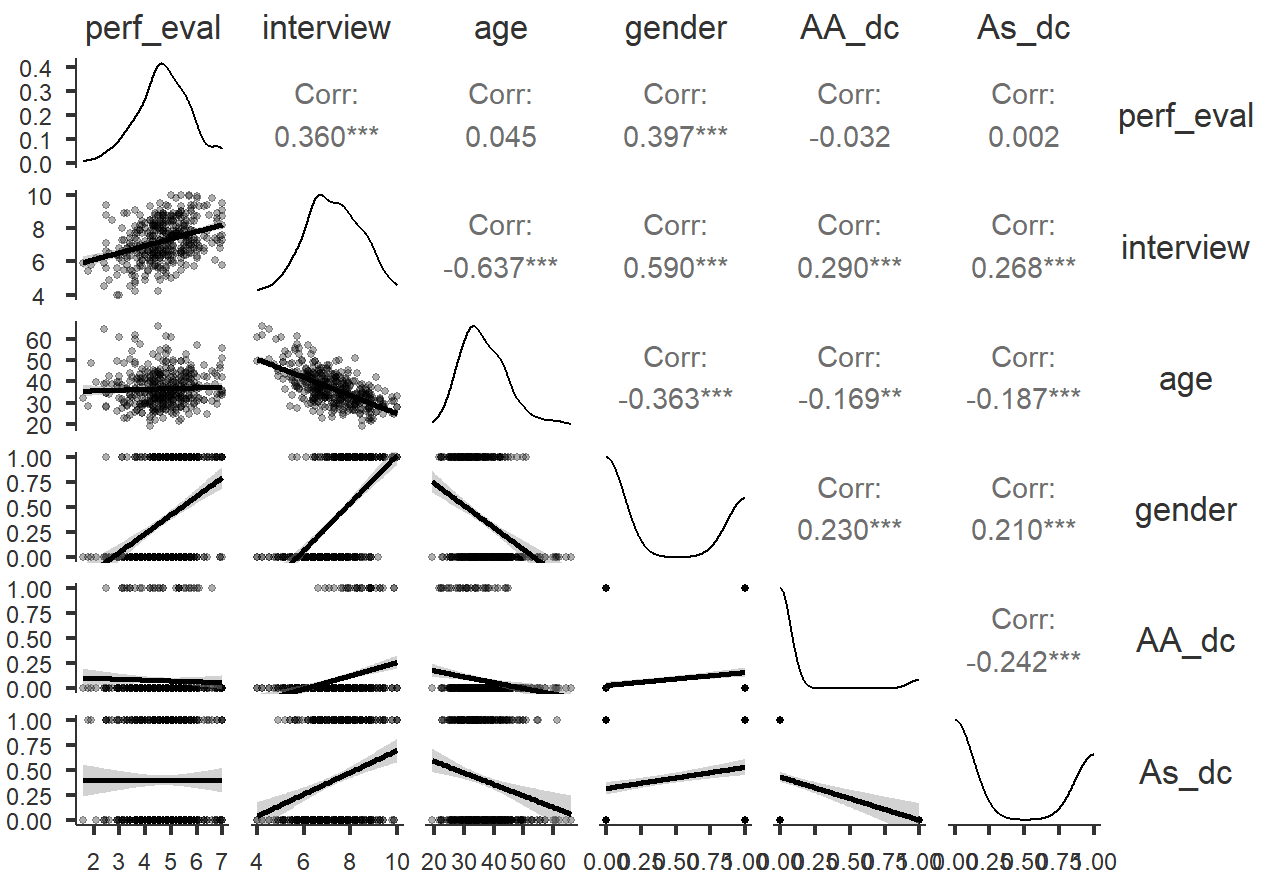
```
dat$genderF <- factor(dat$gender,
                      levels = c(0,1),
                      labels = c("Women","Men"))

describe(dat[2:4])
```

```
##           vars   n  mean   sd median trimmed  mad  min  max range  skew
## perf_eval    1 377  4.71 1.03    4.7    4.72 1.04  1.6  7.0   5.4 -0.13
## interview    2 377  7.26 1.21    7.3    7.26 1.33  4.0 10.0   6.0 -0.05
## age          3 377 36.74 8.03   35.8   36.16 7.71 19.1 66.1  47.0  0.77
##           kurtosis   se
## perf_eval     0.04 0.05
## interview    -0.37 0.06
## age           0.79 0.41
```

```
describeBy(dat[2:4],
           group = dat$genderF,
           mat=TRUE)
```

```
##            item group1 vars   n      mean        sd median   trimmed     mad
## perf_eval1    1  Women    1 237  4.391983 0.9622422   4.40  4.412565 0.88956
## perf_eval2    2    Men    1 140  5.235000 0.9136790   5.25  5.233036 0.81543
## interview1    3  Women    2 237  6.709283 1.0022846   6.70  6.717801 0.88956
## interview2    4    Men    2 140  8.179286 0.9258476   8.20  8.198214 0.88956
## age1          5  Women    3 237 38.983122 8.2834920  38.10 38.447644 7.85778
## age2          6    Men    3 140 32.954286 5.9081991  32.20 32.627679 6.00453
##              min  max range        skew    kurtosis         se
## perf_eval1   1.6  7.0   5.4 -0.17339606  0.09600617 0.06250435
## perf_eval2   2.5  7.0   4.5 -0.08408551 -0.09769623 0.07721997
## interview1   4.0  9.2   5.2 -0.08274133 -0.05116894 0.06510538
## interview2   5.5 10.0   4.5 -0.22775470 -0.23778385 0.07824840
## age1        19.1 66.1  47.0  0.64005520  0.53172073 0.53807062
## age2        21.6 51.1  29.5  0.53625173  0.09885299 0.49933396
```

```
corrMatrix(dat[,c(2:5,9:10)],
           plots = TRUE,
           plotDens = TRUE,
           plotStats = TRUE)$plot
```



Moderation | `linReg()` Technique

```
linReg(data = dat,
       dep = 'perf_eval',
       covs = c('interviewC', 'gender'),
       blocks = list(
         list('interviewC', 'gender')),
       ci = TRUE,
       r2Adj = TRUE,
       modelTest = TRUE,
       stdEst = TRUE,
       ciStdEst = TRUE)
```

```
##
##  LINEAR REGRESSION
##
##  Model Fit Measures
##  ──────────────────────────────────────────────────────────────────────────────────────────
##    Model    R            R²           Adjusted R²    F           df1    df2    p
##  ──────────────────────────────────────────────────────────────────────────────────────────
##        1    0.4262549    0.1816932      0.1773173    41.52066      2    374    < .0000001
##  ──────────────────────────────────────────────────────────────────────────────────────────
##    Note. Models estimated using sample size of N=377
##
##
##  MODEL SPECIFIC RESULTS
##
##  MODEL 1
##
##  Model Coefficients - perf_eval
##  ──────────────────────────────────────────────────────────────────────────────────────────────────────────────────────────────
──────────────────────
##    Predictor     Estimate     SE            Lower         Upper        t            p             Stand. Estimate    Lowe
r         Upper
##  ──────────────────────────────────────────────────────────────────────────────────────────────────────────────────────────────
──────────────────────
##    Intercept     4.4816125    0.06627859    4.35128708    4.6119379    67.617803    < .0000001
##    interviewC    0.1641895    0.04938642    0.06707963    0.2612993     3.324588     0.0009730          0.1925996    0.07
868659    0.3065126
##    gender        0.6016578    0.12305528    0.35969090    0.8436248     4.889330     0.0000015          0.2832480    0.16
933502    0.3971611
##  ──────────────────────────────────────────────────────────────────────────────────────────────────────────────────────────────
──────────────────────
```

```
linReg(data = dat,
       dep = 'perf_eval',
       covs = c('interviewC', 'ageC'),
       blocks = list(
         list('interviewC', 'ageC')),
       ci = TRUE,
       r2Adj = TRUE,
       modelTest = TRUE,
       stdEst = TRUE,
       ciStdEst = TRUE)
```

```
##
##  LINEAR REGRESSION
##
##  Model Fit Measures
##  ──────────────────────────────────────────────────────────────────────────────────────────
##    Model    R            R²           Adjusted R²    F           df1    df2    p
##  ──────────────────────────────────────────────────────────────────────────────────────────
##        1    0.5062494    0.2562884      0.2523113    64.44156      2    374    < .0000001
##  ──────────────────────────────────────────────────────────────────────────────────────────
##    Note. Models estimated using sample size of N=377
##
##
##  MODEL SPECIFIC RESULTS
##
##  MODEL 1
##
##  Model Coefficients - perf_eval
##  ──────────────────────────────────────────────────────────────────────────────────────────────────────────────────────────────
──────────────────────
##    Predictor     Estimate      SE             Lower         Upper         t             p             Stand. Estimate
Lower        Upper
##  ──────────────────────────────────────────────────────────────────────────────────────────────────────────────────────────────
──────────────────────
##    Intercept     4.70503979    0.045766318    4.61504823    4.79503134    102.805731    < .0000001
##    interviewC    0.55761543    0.049316718    0.46064263    0.65458824     11.306824    < .0000001          0.6541011
0.5403488    0.7678534
##    ageC          0.05914438    0.007403700    0.04458628    0.07370247      7.988489    < .0000001          0.4621351
0.3483828    0.5758873
##  ──────────────────────────────────────────────────────────────────────────────────────────────────────────────────────────────
──────────────────────
```

```
# Create our interaction term(s)

dat$int_gender <- dat$interviewC*dat$gender
dat$int_age <- dat$interviewC*dat$ageC


linReg(data = dat,
       dep = 'perf_eval',
       covs = c('interviewC', 'gender','int_gender'),
       blocks = list(
         list('interviewC', 'gender'),
         list('int_gender')),
       ci = TRUE,
       modelTest = TRUE,
       r2Adj = TRUE,
       stdEst = TRUE,
       ciStdEst = TRUE)
```

```
##
##  LINEAR REGRESSION
##
##  Model Fit Measures
##  ──────────────────────────────────────────────────────────────────────────────────────────
##    Model    R            R²           Adjusted R²    F           df1    df2    p
##  ──────────────────────────────────────────────────────────────────────────────────────────
##        1    0.4262549    0.1816932      0.1773173    41.52066      2    374    < .0000001
##        2    0.4447164    0.1977727      0.1913204    30.65183      3    373    < .0000001
##  ──────────────────────────────────────────────────────────────────────────────────────────
##    Note. Models estimated using sample size of N=377
##
##
##  Model Comparisons
##  ──────────────────────────────────────────────────────────────────────────
##    Model         Model    ΔR²           F           df1    df2    p
##  ──────────────────────────────────────────────────────────────────────────
##        1    -        2    0.01607944    7.476224      1    373    0.0065501
##  ──────────────────────────────────────────────────────────────────────────
##
##
##  MODEL SPECIFIC RESULTS
##
##  MODEL 1
##
##  Model Coefficients - perf_eval
##  ──────────────────────────────────────────────────────────────────────────────────────────────────────────────────────────────────
──────────────────────
##    Predictor     Estimate     SE           Lower         Upper        t           p             Stand. Estimate    Lowe
r         Upper
##  ──────────────────────────────────────────────────────────────────────────────────────────────────────────────────────────────────
──────────────────────
##    Intercept     4.4816125    0.06627859    4.35128708    4.6119379    67.617803    < .0000001
##    interviewC    0.1641895    0.04938642    0.06707963    0.2612993     3.324588     0.0009730          0.1925996    0.07
868659    0.3065126
##    gender        0.6016578    0.12305528    0.35969090    0.8436248     4.889330     0.0000015          0.2832480    0.16
933502    0.3971611
##  ──────────────────────────────────────────────────────────────────────────────────────────────────────────────────────────────────
──────────────────────
##
##
##  MODEL 2
##
```

```
##  Model Coefficients - perf_eval
##  ──────────────────────────────────────────────────────────────────────────────────────────────────────────────
──────────────────────────
##    Predictor     Estimate      SE            Lower         Upper          t            p             Stand. Estimate    L
ower         Upper
##  ──────────────────────────────────────────────────────────────────────────────────────────────────────────────
──────────────────────────
##    Intercept      4.5334239    0.06838962     4.3989463     4.66790142    66.288187    < .0000001
##    interviewC     0.2591013    0.06002020     0.1410810     0.37712171     4.316903     0.0000203          0.3039343
0.1654926     0.44237609
##    gender         0.7243668    0.12999579     0.4687503     0.97998327     5.572233    < .0000001          0.3410169
0.2206779     0.46135582
##    int_gender    -0.2837635    0.10378043    -0.4878316    -0.07969549    -2.734268     0.0065501         -0.1984969    -
0.3412456    -0.05574820
##  ──────────────────────────────────────────────────────────────────────────────────────────────────────────────
──────────────────────────
```

```
linReg(data = dat,
       dep = 'perf_eval',
       covs = c('interviewC', 'ageC','int_age'),
       blocks = list(
         list('interviewC', 'ageC'),
         list('int_age')),
       ci = TRUE,
       modelTest = TRUE,
       r2Adj = TRUE,
       stdEst = TRUE,
       ciStdEst = TRUE)
```

```
##
##  LINEAR REGRESSION
##
##  Model Fit Measures
##  ──────────────────────────────────────────────────────────────────────────────────────────
##    Model    R           R²          Adjusted R²    F          df1    df2    p
##  ──────────────────────────────────────────────────────────────────────────────────────────
##        1    0.5062494    0.2562884      0.2523113    64.44156      2    374    < .0000001
##        2    0.5310845    0.2820508      0.2762764    48.84512      3    373    < .0000001
##  ──────────────────────────────────────────────────────────────────────────────────────────
##    Note. Models estimated using sample size of N=377
##
##
##  Model Comparisons
##  ──────────────────────────────────────────────────────────────────────────
##    Model         Model    ΔR²          F          df1    df2    p
##  ──────────────────────────────────────────────────────────────────────────
##        1    -        2    0.02576237    13.38446      1    373    0.0002902
##  ──────────────────────────────────────────────────────────────────────────
##
##
##  MODEL SPECIFIC RESULTS
##
##  MODEL 1
##
##  Model Coefficients - perf_eval
##  ──────────────────────────────────────────────────────────────────────────────────────────────────────────────────────────────────
──────────────────────
##    Predictor     Estimate      SE            Lower         Upper         t            p            Stand. Estimate
Lower        Upper
##  ──────────────────────────────────────────────────────────────────────────────────────────────────────────────────────────────────
──────────────────────
##    Intercept     4.70503979    0.045766318    4.61504823    4.79503134    102.805731    < .0000001
##    interviewC    0.55761543    0.049316718    0.46064263    0.65458824     11.306824    < .0000001          0.6541011
0.5403488    0.7678534
##    ageC          0.05914438    0.007403700    0.04458628    0.07370247      7.988489    < .0000001          0.4621351
0.3483828    0.5758873
##  ──────────────────────────────────────────────────────────────────────────────────────────────────────────────────────────────────
──────────────────────
##
##
##  MODEL 2
##
```

```
##  Model Coefficients - perf_eval
##  ──────────────────────────────────────────────────────────────────────────────────────────────────────────────
──────────────────────────
##    Predictor     Estimate      SE             Lower          Upper         t            p             Stand. Estimate
Lower         Upper
##  ──────────────────────────────────────────────────────────────────────────────────────────────────────────────
──────────────────────────
##    Intercept     4.79527182    0.051339311    4.694321061    4.89622258    93.403510    < .0000001
##    interviewC    0.57216327    0.048682601    0.476436511    0.66789002    11.752931    < .0000001          0.6711662
0.55887559    0.7834568
##    ageC          0.06947120    0.007811884    0.054110345    0.08483205     8.893014    < .0000001          0.5428255
0.42280076    0.6628503
##    int_age       0.01467149    0.004010271    0.006785914    0.02255706     3.658478     0.0002902          0.1755282
0.08118600    0.2698704
##  ──────────────────────────────────────────────────────────────────────────────────────────────────────────────
──────────────────────────
```

Moderation | `lm()` Technique

```
#Interview x Gender Moderation Models
no_mod1 <- lm(perf_eval ~ interviewC + gender, data = dat)
no_mod1Z <- lm(scale(perf_eval) ~ scale(interviewC) + scale(gender), data = dat)

mod1 <- lm(perf_eval ~ interviewC*gender, data = dat)
mod1Z <- lm(scale(perf_eval) ~ scale(interviewC*gender), data = dat)

#Interview x Age Moderation Models
no_mod2 <- lm(perf_eval ~ interviewC + ageC, data = dat)
no_mod2Z <- lm(scale(perf_eval) ~ scale(interviewC) + scale(ageC), data = dat)

mod2 <- lm(perf_eval ~ interviewC*ageC, data = dat)
mod2Z <- lm(scale(perf_eval) ~ scale(interviewC*ageC), data = dat)
```

```
# Direct model comparisons
anova(no_mod1, mod1)
```

```
## Analysis of Variance Table
##
## Model 1: perf_eval ~ interviewC + gender
## Model 2: perf_eval ~ interviewC * gender
##   Res.Df    RSS Df Sum of Sq      F  Pr(>F)
## 1    374 324.95
## 2    373 318.56  1    6.3852 7.4762 0.00655 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
anova(no_mod2, mod2)
```

```
## Analysis of Variance Table
##
## Model 1: perf_eval ~ interviewC + ageC
## Model 2: perf_eval ~ interviewC * ageC
##   Res.Df    RSS Df Sum of Sq      F    Pr(>F)
## 1    374 295.33
## 2    373 285.10  1     10.23 13.384 0.0002902 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
# Model Statistic Summaries for unstandardized regression coefficients
# Uncomment additional summary calls for standardized regression coefficients

summary(no_mod1)
```

```
##
## Call:
## lm(formula = perf_eval ~ interviewC + gender, data = dat)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -2.93543 -0.63543 -0.00836  0.59461  2.75731
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)  4.48161    0.06628  67.618  < 2e-16 ***
## interviewC   0.16419    0.04939   3.325 0.000973 ***
## gender       0.60166    0.12306   4.889  1.5e-06 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.9321 on 374 degrees of freedom
## Multiple R-squared:  0.1817, Adjusted R-squared:  0.1773
## F-statistic: 41.52 on 2 and 374 DF,  p-value: < 2.2e-16
```

```
summary(mod1)
```

```
##
## Call:
## lm(formula = perf_eval ~ interviewC * gender, data = dat)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -2.70489 -0.55275  0.02541  0.58815  2.84361
##
## Coefficients:
##                   Estimate Std. Error t value Pr(>|t|)
## (Intercept)        4.53342    0.06839  66.288  < 2e-16 ***
## interviewC         0.25910    0.06002   4.317 2.03e-05 ***
## gender             0.72437    0.13000   5.572 4.83e-08 ***
## interviewC:gender -0.28376    0.10378  -2.734  0.00655 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.9242 on 373 degrees of freedom
## Multiple R-squared:  0.1978, Adjusted R-squared:  0.1913
## F-statistic: 30.65 on 3 and 373 DF,  p-value: < 2.2e-16
```

```
#summary(no_mod1Z)
#summary(mod1Z)

summary(no_mod2)
```

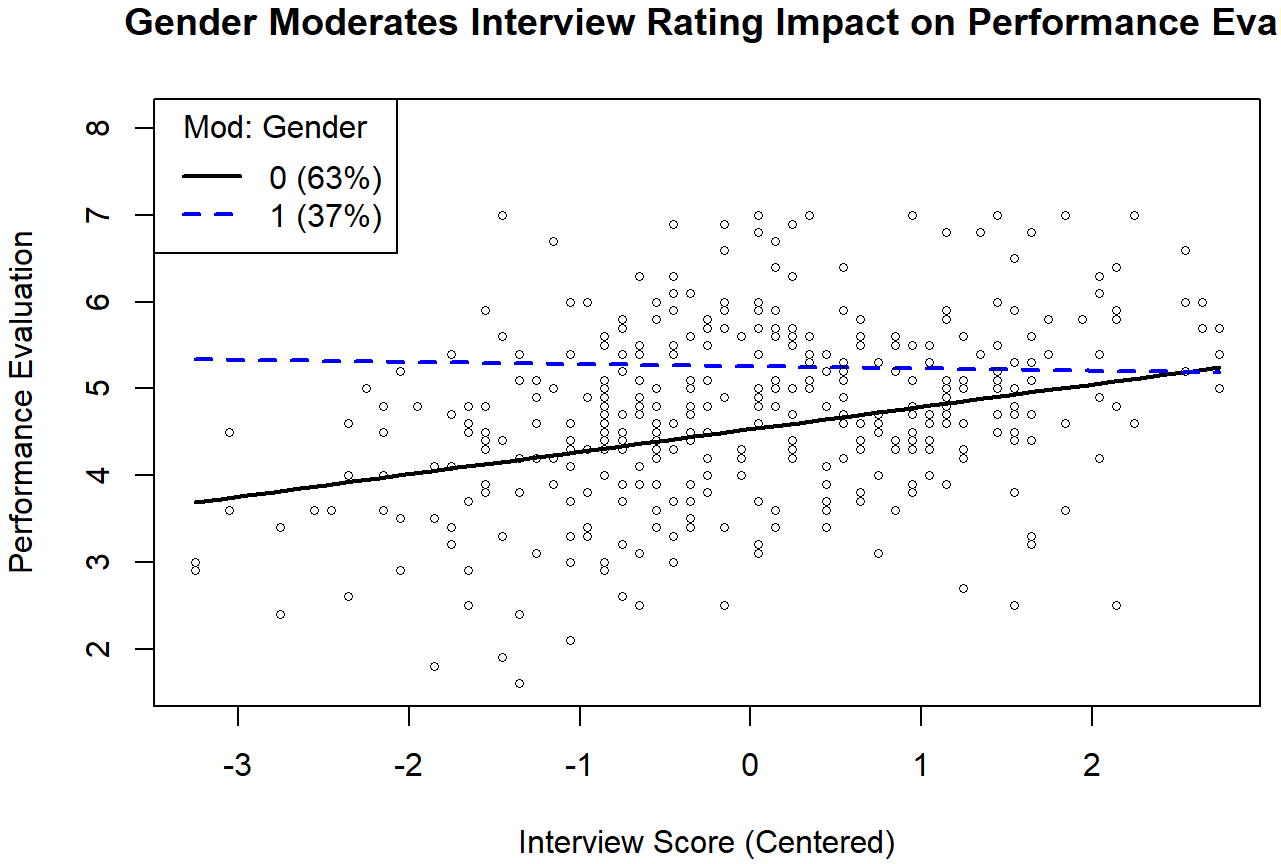
```
##
## Call:
## lm(formula = perf_eval ~ interviewC + ageC, data = dat)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -2.9396 -0.5133 -0.0155  0.5659  2.5057
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept) 4.705040   0.045766 102.806  < 2e-16 ***
## interviewC  0.557615   0.049317  11.307  < 2e-16 ***
## ageC        0.059144   0.007404   7.988 1.71e-14 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.8886 on 374 degrees of freedom
## Multiple R-squared:  0.2563, Adjusted R-squared:  0.2523
## F-statistic: 64.44 on 2 and 374 DF,  p-value: < 2.2e-16
```

```
summary(mod2)
```

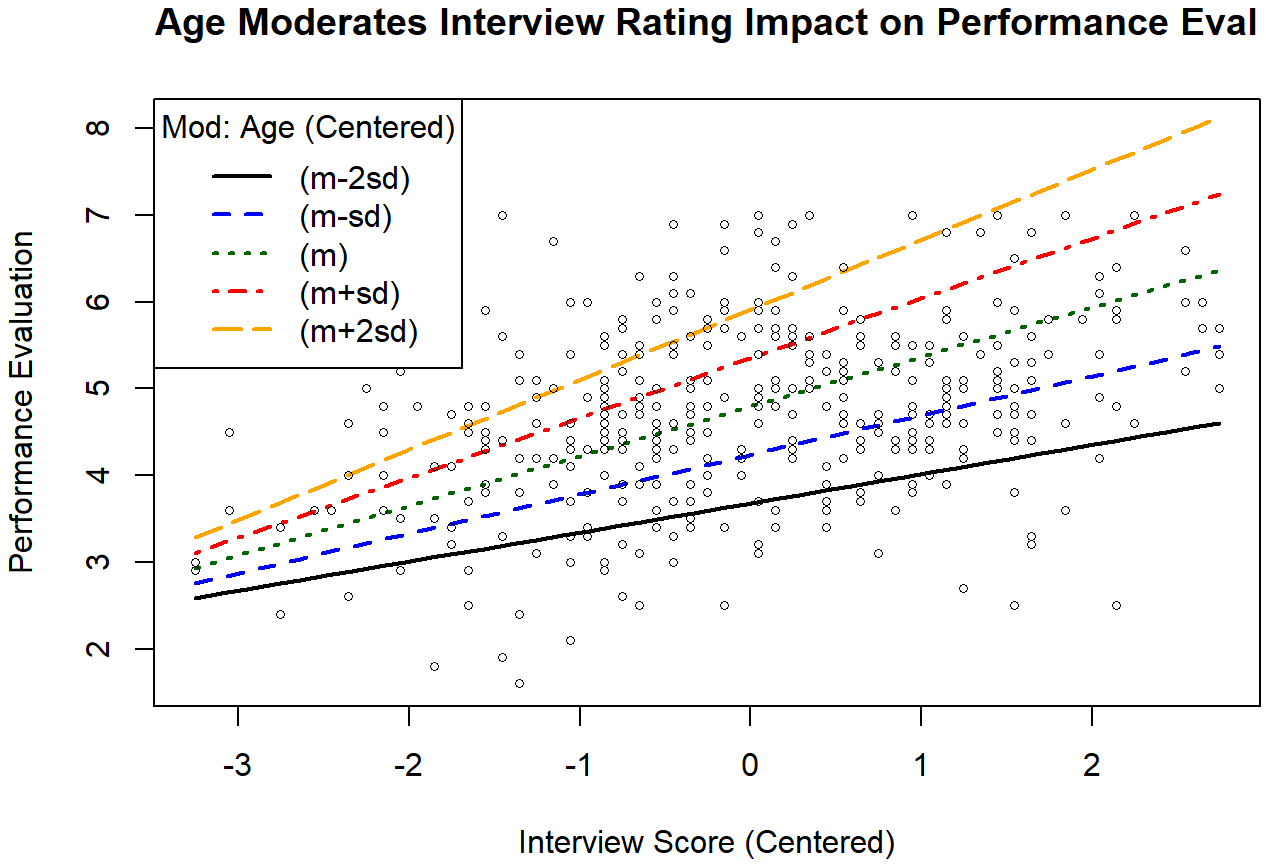
```
##
## Call:
## lm(formula = perf_eval ~ interviewC * ageC, data = dat)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -2.98160 -0.48292 -0.02569  0.54557  2.44720
##
## Coefficients:
##                 Estimate Std. Error t value Pr(>|t|)
## (Intercept)     4.795272   0.051339  93.404  < 2e-16 ***
## interviewC      0.572163   0.048683  11.753  < 2e-16 ***
## ageC            0.069471   0.007812   8.893  < 2e-16 ***
## interviewC:ageC 0.014671   0.004010   3.658  0.00029 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.8743 on 373 degrees of freedom
## Multiple R-squared:  0.2821, Adjusted R-squared:  0.2763
## F-statistic: 48.85 on 3 and 373 DF,  p-value: < 2.2e-16
```

```
#summary(no_mod2Z)
#summary(mod2Z)
```

```
# Visualization of Moderation Plots
plotSlopes(mod1,
           plotx = "interviewC",
           modx = "gender",
           main = "Gender Moderates Interview Rating Impact on Performance Eval",
           xlab = "Interview Score (Centered)",
           ylab = "Performance Evaluation",
           modxVals = "std.dev.",
           legendArgs = list(title = "Mod: Gender"))
```




```
plotSlopes(mod2,
           plotx = "interviewC",
           modx = "ageC",
           main = "Age Moderates Interview Rating Impact on Performance Eval",
           xlab = "Interview Score (Centered)",
           ylab = "Performance Evaluation",
           modxVals = "std.dev.",
           n = 5,
           legendArgs = list(title = "Mod: Age (Centered)"))
```



Mediation Tutorial Markdown

We are going to use `dat2` for a tutorial on mediation analyses. This data set consists of customer product review data. A product was reviewed by customers based on how much they enjoy the product (`Enjoy`), the quality of the product (`Qual`), how excited the customer was to purchase the item (`Excite`), how happy the purchase made the customer (`Happy`), and how much intent went into the purchase (`Intent`).

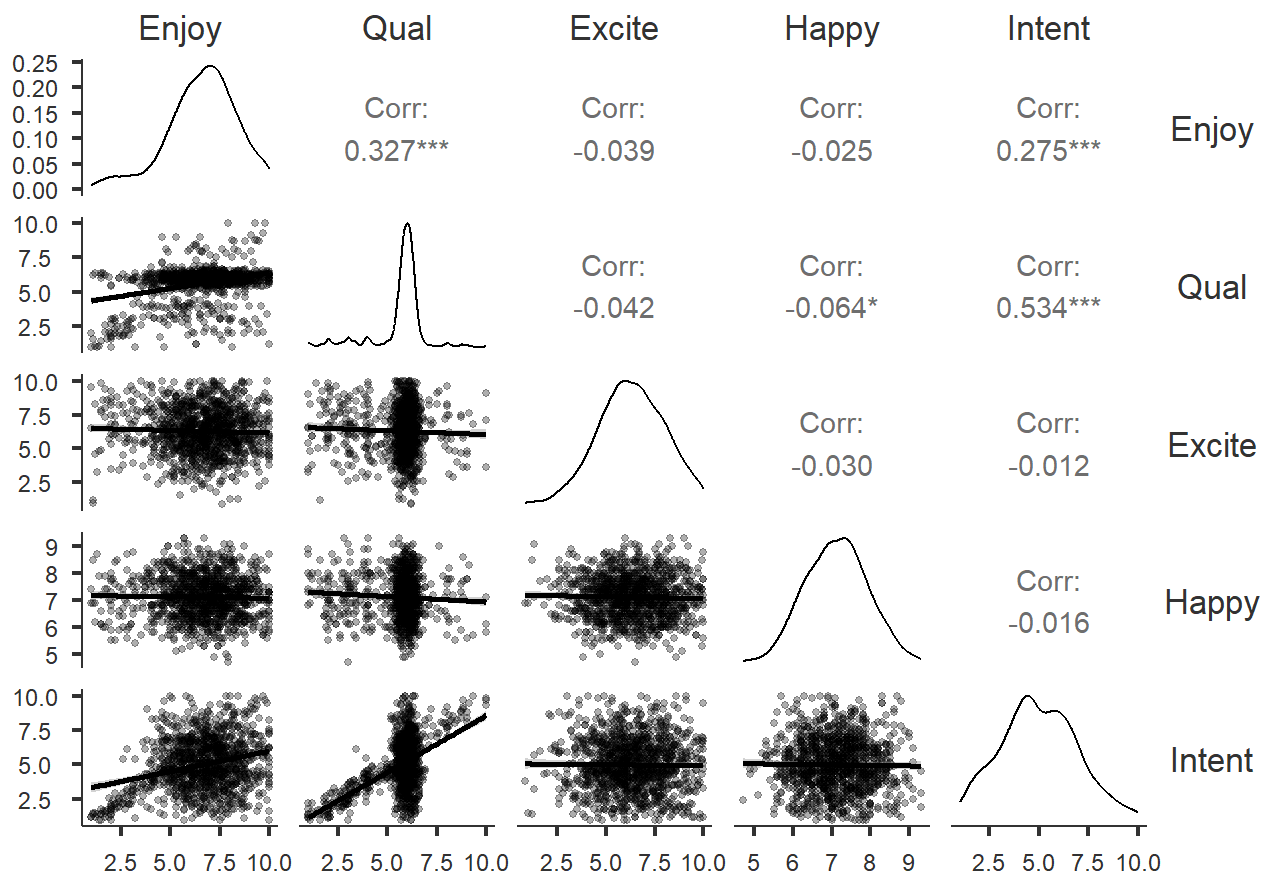
Applied prompt: The product manager wants to know how enjoyment of the product impacts quality ratings and whether the association between these variables can be accounted for by the intent of purchasing the product. We will treat quality as the criterion variable for this tutorial, with enjoyment and intent as predictor and mediator, respectively.

Calculate Descriptive Statistics and Correlation Matrix

```
describe(dat2[2:6])
```

```
##        vars    n mean   sd median trimmed  mad  min  max range  skew kurtosis
## Enjoy     1 1150 6.60 1.77    6.8    6.70 1.63 1.00 10.0  9.00 -0.59     0.45
## Qual      2 1150 5.65 1.24    5.9    5.85 0.44 1.00 10.0  9.00 -1.45     3.73
## Excite    3 1150 6.30 1.70    6.3    6.32 1.78 0.87 10.0  9.13 -0.13    -0.25
## Happy     4 1150 7.12 0.79    7.1    7.12 0.89 4.70  9.3  4.60  0.02    -0.31
## Intent    5 1150 5.00 1.91    4.9    4.97 1.93 1.00 10.0  9.00  0.15    -0.41
##          se
## Enjoy  0.05
## Qual   0.04
## Excite 0.05
## Happy  0.02
## Intent 0.06
```

```
corrMatrix(dat2[2:6],
           plots = TRUE,
           plotDens = TRUE,
           plotStats = TRUE)$plot
```



Mediation | `linReg()` Technique

```
#Indirect Path (a): M ~ X

linReg(data=dat2,
       dep=Intent,
       covs=c(Enjoy),
       blocks=list(
         list('Enjoy')),
       ci = TRUE,
       modelTest = TRUE,
       r2Adj = TRUE,
       stdEst = TRUE,
       ciStdEst = TRUE)
```

```
##
##  LINEAR REGRESSION
##
##  Model Fit Measures
##  ──────────────────────────────────────────────────────────────────────────────────────────
##    Model    R            R²           Adjusted R²    F           df1    df2     p
##  ──────────────────────────────────────────────────────────────────────────────────────────
##        1    0.2748678    0.07555232     0.07474705    93.82258      1    1148    < .0000001
##  ──────────────────────────────────────────────────────────────────────────────────────────
##    Note. Models estimated using sample size of N=1150
##
##
##  MODEL SPECIFIC RESULTS
##
##  MODEL 1
##
##  Model Coefficients - Intent
##  ──────────────────────────────────────────────────────────────────────────────────────────────────────────────────────────
──────────────────
##    Predictor    Estimate     SE            Lower        Upper        t            p             Stand. Estimate    Lower
Upper
##  ──────────────────────────────────────────────────────────────────────────────────────────────────────────────────────────
──────────────────
##    Intercept    3.0442381    0.20904014    2.6340946    3.4543817    14.562936    < .0000001
##    Enjoy        0.2963183    0.03059178    0.2362962    0.3563404     9.686206    < .0000001          0.2748678    0.2191
907    0.3305449
##  ──────────────────────────────────────────────────────────────────────────────────────────────────────────────────────────
──────────────────
```

```
# Step 1: Y ~ X (Path c) <br>
# Step 2: Y ~ X + Med (Paths b and c')
linReg(data=dat2,
       dep=Qual,
       covs=c(Enjoy,Intent),
       blocks=list(
         list('Enjoy'),
         list('Intent')),
       ci = TRUE,
       modelTest = TRUE,
       r2Adj = TRUE,
       stdEst = TRUE,
       ciStdEst = TRUE)
```

Mediation | `lm()` Technique

```
# Standardized Direct Path (c)
lm1Z <- lm(scale(Qual)~scale(Enjoy), dat2)
lm1 <- lm(Qual ~ Enjoy, dat2)

# Standardized Indirect Path (a)
lm2Z <- lm(scale(Intent) ~ scale(Enjoy), dat2)
lm2 <- lm(Intent ~ Enjoy, dat2)

# Standardized Direct Path (c') and Indirect Path (b)
lm3Z <- lm(scale(Qual) ~ scale(Enjoy) + scale(Intent), dat2)
lm3 <- lm(Qual ~ Enjoy + Intent, dat2)

# Model Comparison for Mediation Effect
anova(lm1Z, lm3Z)
```

```
## Analysis of Variance Table
##
## Model 1: scale(Qual) ~ scale(Enjoy)
## Model 2: scale(Qual) ~ scale(Enjoy) + scale(Intent)
##   Res.Df     RSS Df Sum of Sq     F    Pr(>F)
## 1   1148 1026.37
## 2   1147  781.13  1    245.23 360.1 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
# Model Statistic Summaries
summary(lm1Z)
```

```
##
## Call:
## lm(formula = scale(Qual) ~ scale(Enjoy), data = dat2)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -4.2213 -0.1969  0.1601  0.4667  3.2727
##
## Coefficients:
##                Estimate Std. Error t value Pr(>|t|)
## (Intercept)  -6.633e-16  2.788e-02    0.00        1
## scale(Enjoy)  3.267e-01  2.789e-02   11.71   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.9455 on 1148 degrees of freedom
## Multiple R-squared:  0.1067, Adjusted R-squared:  0.106
## F-statistic: 137.2 on 1 and 1148 DF,  p-value: < 2.2e-16
```

```
summary(lm2Z)
```

```
##
## Call:
## lm(formula = scale(Intent) ~ scale(Enjoy), data = dat2)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -2.62268 -0.69007 -0.02905  0.63435  2.86714
##
## Coefficients:
##                Estimate Std. Error t value Pr(>|t|)
## (Intercept)  -7.178e-16  2.836e-02   0.000        1
## scale(Enjoy)  2.749e-01  2.838e-02   9.686   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.9619 on 1148 degrees of freedom
## Multiple R-squared:  0.07555,    Adjusted R-squared:  0.07475
## F-statistic: 93.82 on 1 and 1148 DF,  p-value: < 2.2e-16
```

```
summary(lm3Z)
```

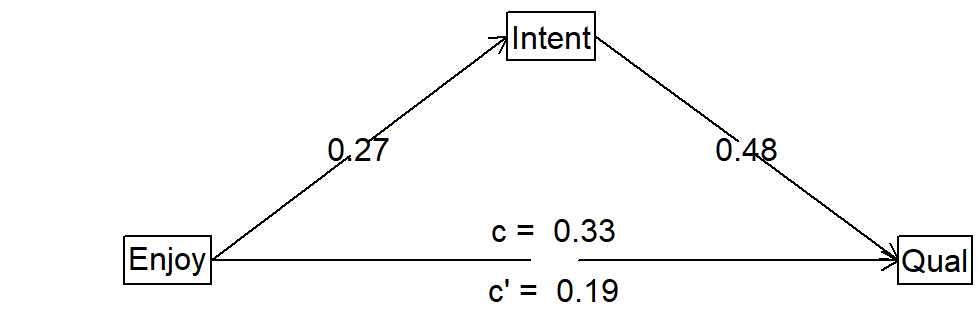
```
##
## Call:
## lm(formula = scale(Qual) ~ scale(Enjoy) + scale(Intent), data = dat2)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -3.2158 -0.3949  0.0633  0.5528  2.2875
##
## Coefficients:
##                 Estimate Std. Error t value Pr(>|t|)
## (Intercept)   -3.184e-16  2.434e-02   0.000        1
## scale(Enjoy)   1.946e-01  2.532e-02   7.686 3.24e-14 ***
## scale(Intent)  4.805e-01  2.532e-02  18.976  < 2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.8252 on 1147 degrees of freedom
## Multiple R-squared:  0.3202, Adjusted R-squared:  0.319
## F-statistic: 270.1 on 2 and 1147 DF,  p-value: < 2.2e-16
```

```
# Conducting Sobel's Indirect Effect Test
sobel(pred=dat2$Enjoy, med=dat2$Intent,out=dat2$Qual)
```

```
## $`Mod1: Y~X`
##              Estimate Std. Error  t value      Pr(>|t|)
## (Intercept) 4.1429833 0.13326961 31.08723 1.944383e-154
## pred        0.2284179 0.01950322 11.71181  5.230990e-30
##
## $`Mod2: Y~X+M`
##              Estimate Std. Error   t value      Pr(>|t|)
## (Intercept) 3.1943037 0.12660257 25.230955 4.319906e-112
## pred        0.1360759 0.01770375  7.686275  3.240738e-14
## med         0.3116312 0.01642218 18.976240  4.756102e-70
##
## $`Mod3: M~X`
##              Estimate Std. Error   t value     Pr(>|t|)
## (Intercept) 3.0442381 0.20904014 14.562936 3.267375e-44
## pred        0.2963183 0.03059178  9.686206 2.211602e-21
##
## $Indirect.Effect
## [1] 0.09234202
##
## $SE
## [1] 0.01070349
##
## $z.value
## [1] 8.627283
##
## $N
## [1] 1150
```

Visualization of Mediation Model

```
mediate(Qual ~ Enjoy + (Intent),
        data = dat2,
        std = TRUE,
        main = "Predicting Quality from Enjoyment Mediated by Intention"
        )$plot
```


Predicting Quality from Enjoyment Mediated by Intention
Intent
0.27
0.48
c = 0.33
Enjoy
Qual
c' = 0.19

```
## NULL
```