Summary demo of testing

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```r
cbind(y,g,w,x)
```

```
##                   y  g            w           x
##  [1,]  5.38564217  1  1.262954285  0.76359346
##  [2,]  2.73403976  1  1.262954285 -0.79900925
##  [3,]  1.20281614  1  1.262954285 -1.14765701
##  [4,]  2.79396460  1  1.262954285 -0.28946157
##  [5,]  2.55931589  1  1.262954285 -0.29921512
##  [6,] -1.36997356  2 -0.326233361 -0.41151083
##  [7,]  2.12259839  2 -0.326233361  0.25222345
##  [8,] -2.72981638  2 -0.326233361 -0.89192113
##  [9,]  2.95561553  2 -0.326233361  0.43568330
## [10,] -2.88868614  2 -0.326233361 -1.23753842
## [11,]  3.41823407  3  1.329799263 -0.22426789
## [12,]  2.85540740  3  1.329799263  0.37739565
## [13,]  3.08406108  3  1.329799263  0.13333636
## [14,]  3.98968262  3  1.329799263  0.80418951
## [15,]  3.16241949  3  1.329799263 -0.05710677
## [16,]  5.02956771  4  1.272429321  0.50360797
## [17,]  6.33947263  4  1.272429321  1.08576936
## [18,]  2.85333026  4  1.272429321 -0.69095384
## [19,] -0.11920309  4  1.272429321 -1.28459935
## [20,]  4.56297162  4  1.272429321  0.04672617
## [21,]  1.01078311  5  0.414641434 -0.23570656
## [22,] -1.57140296  5  0.414641434 -0.54288826
## [23,] -1.04549513  5  0.414641434 -0.43331032
## [24,] -1.10318913  5  0.414641434 -0.64947165
## [25,]  2.30551118  5  0.414641434  0.72675075
## [26,]  2.82892707  6 -1.539950042  1.15191175
## [27,]  0.40426401  6 -1.539950042  0.99216037
## [28,] -1.73716896  6 -1.539950042 -0.42951311
## [29,]  2.05824638  6 -1.539950042  1.23830410
```

```r
## full model
fit1<-lm(y ~ 1 + w + x + w:x + as.factor(g) + as.factor(g):x )

anova(fit1)
```

```
## Analysis of Variance Table
##
## Response: y
##                 Df  Sum Sq Mean Sq  F value    Pr(>F)
## w                1 183.410 183.410 382.5574 < 2.2e-16 ***
## x                1 304.179 304.179 634.4572 < 2.2e-16 ***
## as.factor(g)     8  44.468   5.559  11.5940  2.48e-07 ***
## w:x              1   0.005   0.005   0.0105   0.91892
## x:as.factor(g)   8  11.513   1.439   3.0016   0.01346 *
## Residuals       30  14.383   0.479
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```r
## test w
fit0<-lm(y ~ 1 + x + w:x + as.factor(g) + as.factor(g):x )

anova(fit0,fit1)
```

```
## Analysis of Variance Table
##
## Model 1: y ~ 1 + x + w:x + as.factor(g) + as.factor(g):x
## Model 2: y ~ 1 + w + x + w:x + as.factor(g) + as.factor(g):x
##   Res.Df    RSS Df  Sum of Sq F Pr(>F)
## 1     30 14.383
## 2     30 14.383  0 5.3291e-15
```

```r
## test x
fit0<-lm(y ~ 1 + w +  w:x + as.factor(g) + as.factor(g):x )
anova(fit0,fit1)

## Analysis of Variance Table
##
## Model 1: y ~ 1 + w + w:x + as.factor(g) + as.factor(g):x
## Model 2: y ~ 1 + w + x + w:x + as.factor(g) + as.factor(g):x
##   Res.Df    RSS Df   Sum of Sq F Pr(>F)
## 1     30 14.383
## 2     30 14.383  0 -7.1054e-15

## test w:x
fit0<-lm(y ~ 1 + w + as.factor(g) + as.factor(g):x )
anova(fit0,fit1)

## Analysis of Variance Table
##
## Model 1: y ~ 1 + w + as.factor(g) + as.factor(g):x
## Model 2: y ~ 1 + w + x + w:x + as.factor(g) + as.factor(g):x
##   Res.Df    RSS Df  Sum of Sq F Pr(>F)
## 1     30 14.383
## 2     30 14.383  0 1.7764e-15
```

```r
## test g
fit0<-lm(y ~ 1 + w +  as.factor(g):x )
anova(fit0,fit1)
```

```
## Analysis of Variance Table
##
## Model 1: y ~ 1 + w + as.factor(g):x
## Model 2: y ~ 1 + w + x + w:x + as.factor(g) + as.factor(g):x
##   Res.Df    RSS Df Sum of Sq      F    Pr(>F)
## 1     38 55.090
## 2     30 14.383  8    40.707 10.613 6.282e-07 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```r
## test g:x
fit0<-lm(y ~ 1 + w + as.factor(g) )
anova(fit0,fit1)
```

```
## Analysis of Variance Table
##
## Model 1: y ~ 1 + w + as.factor(g)
## Model 2: y ~ 1 + w + x + w:x + as.factor(g) + as.factor(g):x
##   Res.Df     RSS Df Sum of Sq      F    Pr(>F)
## 1     40 304.355
## 2     30  14.383 10    289.97 60.483 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

We can construct an f-test for a fixed effect of a micro variable, if there is no across-group heterogeneity *in that effect*:

```
fit1<-lm(y ~ 1 + w + x + w:x + as.factor(g) )

fit0<-lm(y ~ 1 + w + x + as.factor(g) )

anova(fit0,fit1) # test x:x
```

```
## Analysis of Variance Table
##
## Model 1: y ~ 1 + w + x + as.factor(g)
## Model 2: y ~ 1 + w + x + w:x + as.factor(g)
##   Res.Df    RSS Df Sum of Sq      F Pr(>F)
## 1     39 25.901
## 2     38 25.895  1 0.0050523 0.0074 0.9318
```

```
fit0<-lm(y ~ 1 + w + w:x + as.factor(g) )

anova(fit0,fit1) # test x
```

```
## Analysis of Variance Table
##
## Model 1: y ~ 1 + w + w:x + as.factor(g)
## Model 2: y ~ 1 + w + x + w:x + as.factor(g)
##   Res.Df     RSS Df Sum of Sq      F    Pr(>F)
## 1     39 290.454
## 2     38  25.895  1    264.56 388.22 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```r
fit1<-lmer(y ~ 1 + w + x + w:x + (1 + x|g),REML=FALSE )

fit0<-lmer(y ~ 1 + x + w:x + (1 + x|g),REML=FALSE )

x2<-2*(logLik(fit1)-logLik(fit0))

x2

## 'log Lik.' 19.89287 (df=8)

1-pchisq(x2,1)

## 'log Lik.' 8.190541e-06 (df=8)

anova(fit0,fit1) # test w

## Data: NULL
## Models:
## fit0: y ~ 1 + x + w:x + (1 + x | g)
## fit1: y ~ 1 + w + x + w:x + (1 + x | g)
##      npar    AIC    BIC  logLik deviance  Chisq Df Pr(>Chisq)
## fit0    7 172.06 185.45 -79.032   158.06
## fit1    8 154.17 169.47 -69.086   138.17 19.893  1  8.191e-06 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```r
fit0<-lmer(y ~ 1 + w + w:x + (1 + x|g),REML=FALSE )

anova(fit0,fit1) # test x
```

```
## Data: NULL
## Models:
## fit0: y ~ 1 + w + w:x + (1 + x | g)
## fit1: y ~ 1 + w + x + w:x + (1 + x | g)
##      npar    AIC    BIC  logLik deviance  Chisq Df Pr(>Chisq)
## fit0    7 179.66 193.05 -82.832   165.66
## fit1    8 154.17 169.47 -69.086   138.17 27.492  1  1.578e-07 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```r
fit0<-lmer(y ~ 1 + w + x + (1 + x|g),REML=FALSE )

anova(fit0,fit1)
```

```
## Data: NULL
## Models:
## fit0: y ~ 1 + w + x + (1 + x | g)
## fit1: y ~ 1 + w + x + w:x + (1 + x | g)
##      npar    AIC    BIC  logLik deviance  Chisq Df Pr(>Chisq)
## fit0    7 152.50 165.89 -69.252   138.50
## fit1    8 154.17 169.47 -69.086   138.17 0.3317  1     0.5647
```

```r
fit0<-lmer(y ~ 1 + w + x + w:x + (1|g),REML=FALSE )

anova(fit0,fit1) # test x|g
```

```
## Data: NULL
## Models:
## fit0: y ~ 1 + w + x + w:x + (1 | g)
## fit1: y ~ 1 + w + x + w:x + (1 + x | g)
##      npar    AIC    BIC  logLik deviance  Chisq Df Pr(>Chisq)
## fit0    6 151.29 162.76 -69.643   139.29
## fit1    8 154.17 169.47 -69.086   138.17 1.1143  2     0.5728
```

```r
x2<- 2*(logLik(fit1)-logLik(fit0))

x2
```

```
## 'log Lik.' 1.114333 (df=8)
```

```r
1-pchisq(x2,2)
```

```
## 'log Lik.' 0.5728298 (df=8)
```

```r
.5*( 1-pchisq(x2,1) + 1-pchisq(x2,2) )
```

```
## 'log Lik.' 0.4319858 (df=8)
```

```
fit0<-lmer(y ~ 1 + w + x + w:x )
## Error:  No random effects terms specified in formula
fit0<-lm(y ~ 1 + w + x + w:x )
anova(fit0,fit1)
## Error in x$terms:  $ operator not defined for this S4 class
```