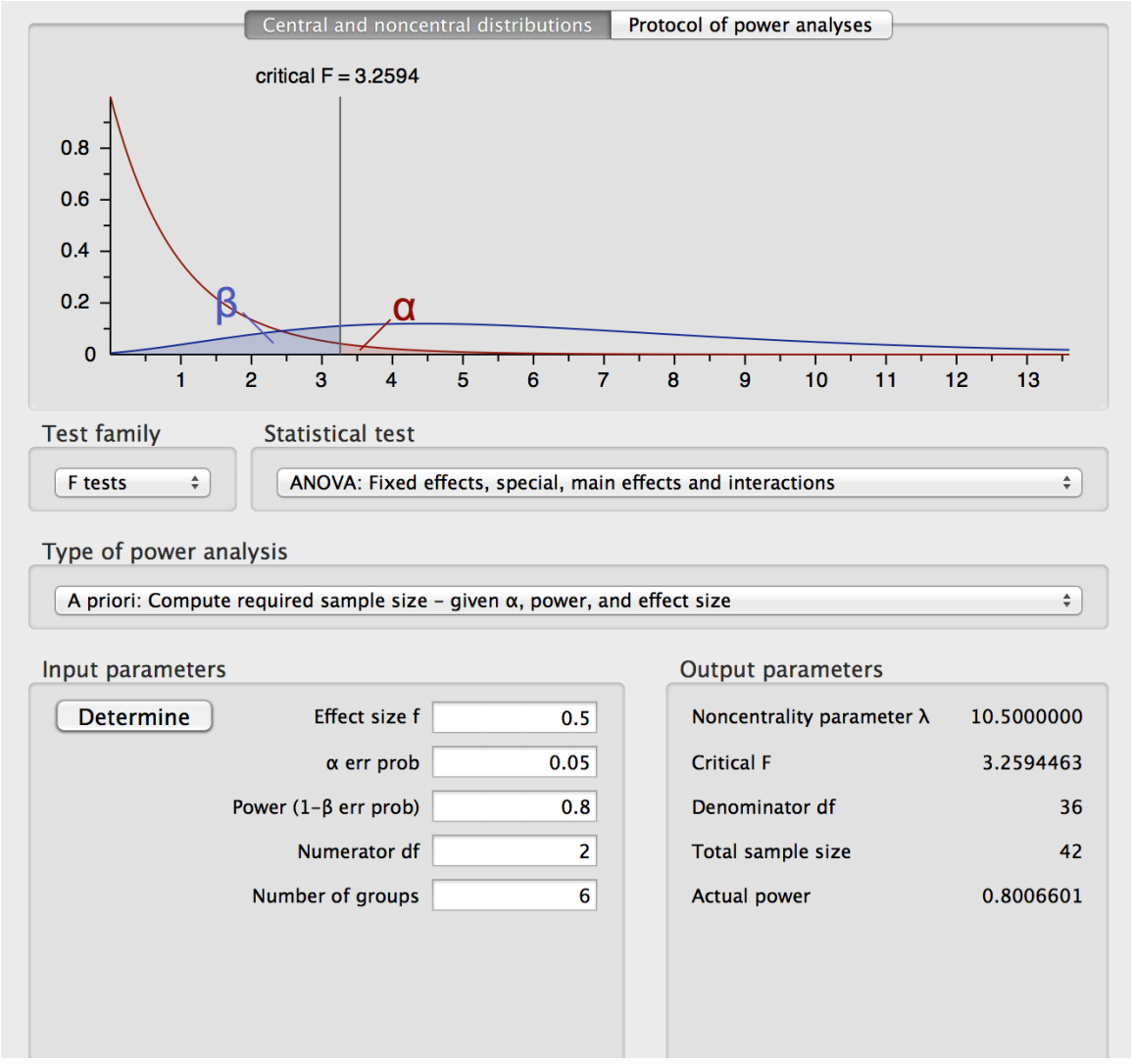
Data:

42 obs

42 observations of 4 variables

	name	gender	treatment	time
1	Rebeka Novak	f	Adrenaline	22.0
2	Chloe Castro	f	Adrenaline	20.1
3	Nanami Lopez	f	Adrenaline	21.2
4	Maria Durand	f	Adrenaline	20.1
5	Eva Durand	f	Adrenaline	19.2
6	Emily Fiala	f	Adrenaline	18.1
7	Aya Carrasco	f	Adrenaline	16.2
8	rosalie steiner	f	Energy Drink	22.7
9	Siobhan Kennedy	f	Energy Drink	19.3
10	Monserrat Carrasco	f	Energy Drink	15.2
11	Alejandra Durand	f	Energy Drink	22.6
12	Ciara Durand	f	Energy Drink	12.6
13	Antonia Durand	f	Energy Drink	10.3
14	Pia Summers	f	Energy Drink	17.7
15	Tjasa Gonzalez	f	Methamphetamine	24.0
16	Anna Bernard	f	Methamphetamine	13.5
17	Nanami McCarthy	f	Methamphetamine	14.4
18	Ellen Durand	f	Methamphetamine	10.2
19	Sophie Kennedy	f	Methamphetamine	15.1
20	Sophie Takahashi	f	Methamphetamine	23.0
21	Mayu Carrasco	f	Methamphetamine	14.3

Sample size:


Central and noncentral distributions
Protocol of power analyses
critical F = 3.2594
0.8
0.6
0.4
0.2
0
β
α
1
2
3
4
5
6
7
8
9
10
11
12
13
Test family
F tests
Statistical test
ANOVA: Fixed effects, special, main effects and interactions
Type of power analysis
A priori: Compute required sample size – given α, power, and effect size
Input parameters
Determine
Effect size f
0.5
α err prob
0.05
Power (1–β err prob)
0.8
Numerator df
2
Number of groups
6
Output parameters
Noncentrality parameter λ
10.5000000
Critical F
3.2594463
Denominator df
36
Total sample size
42
Actual power
0.8006601

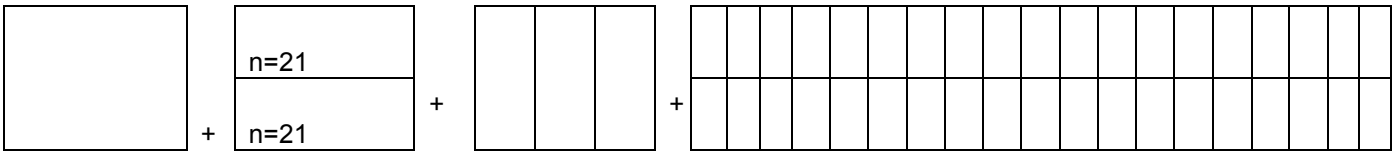
We tried BF[1] first.

```
> m0 <- aov(time~factor(treatment),data=d1)
> summary(m0)
                    Df    Sum Sq   Mean Sq  F value   Pr(>F)
factor(treatment)    2     196.3     98.14    3.803   0.031 *
Residuals           39    1006.4     25.81
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
>


> model.tables(m0)
Tables of effects

 factor(treatment)
factor(treatment)
    Adrenaline    Energy Drink Methamphetamine
        2.8357         -2.4071         -0.4286
```

The estimated effects for Adrenaline is 2.8357.
The estimated effects for Energy Drinkis -2.4071.
The estimated effects for Methamphetamine is -0.4286.

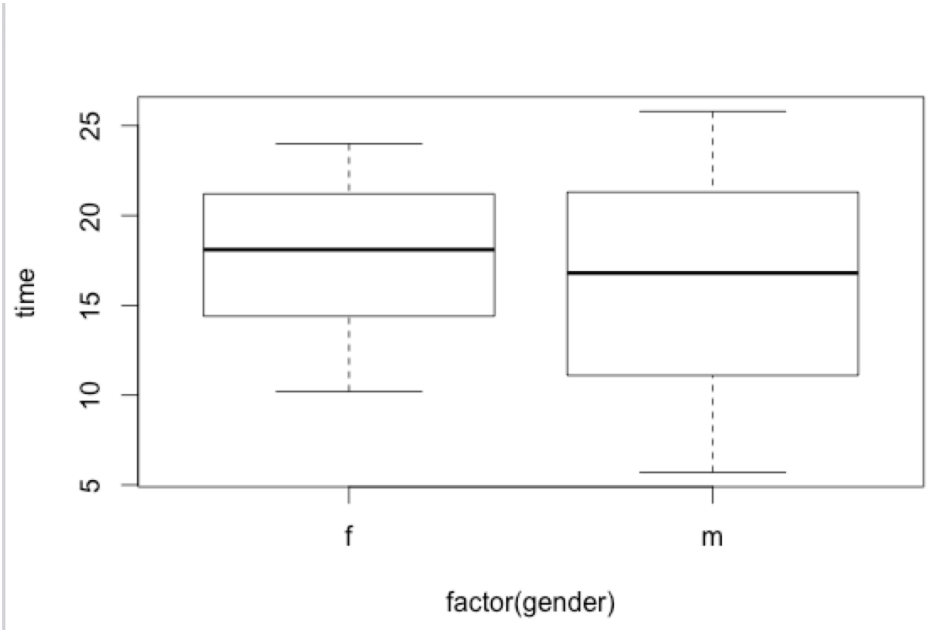


Blocking on the gender to increase power!

Factor Diagram CB[1]: Total 42 units and we blocking on gender.
Our treatment has three levels (Adrenaline, Energy Drink,

Methamphetamine), Each unit of block randomly get one treatment, and each block gets a complete set of treatment.

Plot of gender:

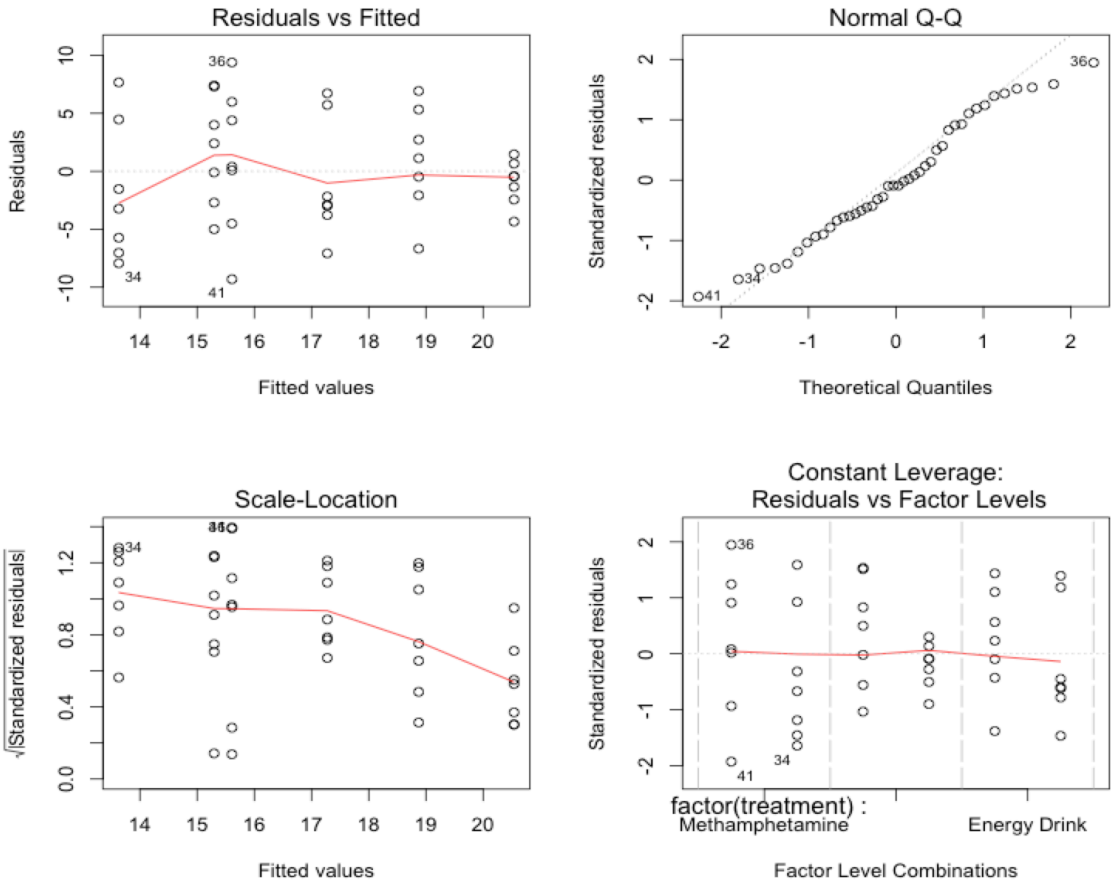


The mean difference between female and male are not that big.

```
> m1 <- aov(time~factor(treatment)+factor(gender),data=d1)
> summary(m1)
                   Df Sum      Sq Mean     Sq F value   Pr(>F)
factor(treatment)  2  196.3    98.14       3.816        0.0309 *
factor(gender)     1   29.2    29.17       1.134        0.2936
Residuals          38  977.2   25.72
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
>
```

Conclusion: Gender is a nuisance factor that we are not interesting, but after blocking on gender, the p-value decreased from 0.031 to 0.039 and power increased. The effect of treatments is become more statically significant after we blocking on gender.

Residual VS Fitted value and QQ Normal:

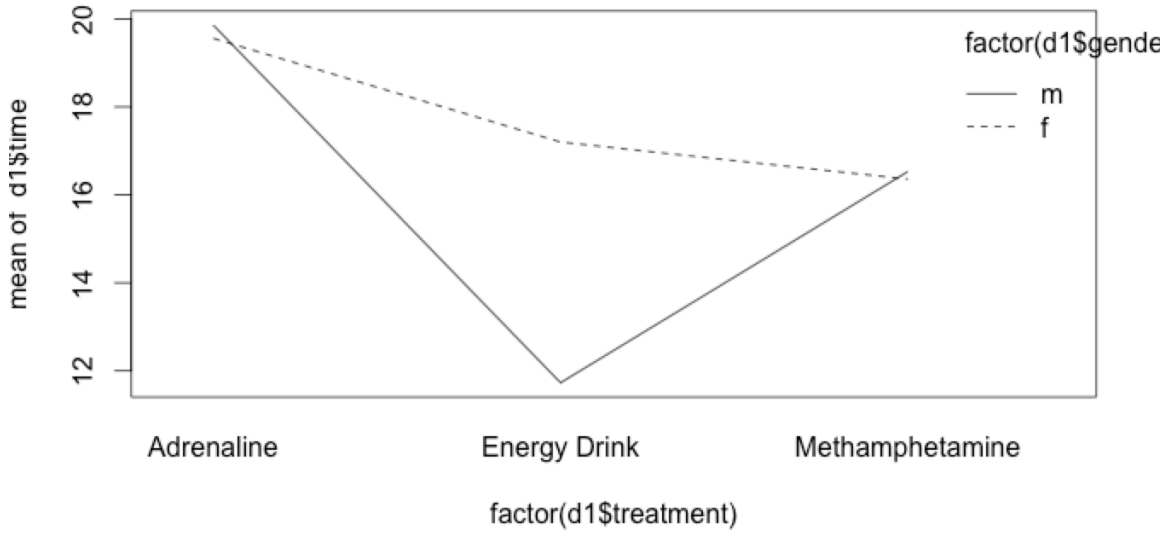


Try BF[2] to check whether interaction helps.

```
> m2 <- aov(time~factor(treatment)*factor(gender),data=d1)
> summary(m2)
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
factor(treatment)	2	196.3	98.14	3.920	0.0288 *
factor(gender)	1	29.2	29.17	1.165	0.2876
factor(treatment):factor(gender)	2	76.0	38.01	1.519	0.2327
Residuals	36	901.2	25.03		

```
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```



From the interaction we see difference between groups, since the p-value of interaction is greater than 0.05, we conclude that the interaction is not statistically significant. Therefore, the CB[1] is the best design for our experiment.