IE 511 DOE Term Project

Cook Pasta Simply

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12/6/2018

Introduction

Motivation of the experiment

Pasta is my go-to food when I do not have a specific preference because it does not require much time and effort to cook it. Since I fell in love with pasta, I have searched on the Internet or asked friends that how to cook it better. However, there have been so many tips for making delicious pasta noodles that cause information overload making me confused and the process complicated. *Now I want to discard some tips that would not have big effects.*

Objective of the experiment

- To find factors having significant effects on the quality of pasta noodles to simplify the cooking process
- To find a simple recipe of cooking pasta noodles without compromising quality

Factors to Be Inspected

Factor	Level 1 (+)	Level 2(-)	Comment
Olive oil	10ml	None	Use a scaler
Chicken Stock	10ml	None	Use a scaler
Stove Temperature	Highest	Middle	Use two different stoves (blocks)
Amount of salt	5g	2g	Use a scaler
Noodle Brand	Dreamfields Angel Hair	Barilla White Fiber	With similar prices and types
Wash with cool water	With running tap water	None	After cooking noodles

- Experimental units are pasta noodles and response is the mean of three testers' rates
  - Variance of rates is discarded as most of them are 1/3
- Brands of ingredients: Giant Extra Virgin Olive Oil and Kitchen Basics Original Chicken Stock
- I put pasta noodles after water starting to boil and cook it for 5 minuates
- I used the same amount of water (3 cups by my tumbler), while it probably not exactly the same for each time, but I assume this variation is not significant
- I used `R` for the analysis

Design of the Experiment

Block	Standard Order	Run Order	Treatment	A	B	C	D	E=ABC	F=BCD	ABD
1	2	1	ae	+	-	-	-	+	-	+
	3	2	bef	-	+	-	-	+	+	+
	7	3	bc	-	+	+	-	-	-	+
	9	4	df	-	-	-	+	-	+	+
	16	5	abcdef	+	+	+	+	+	+	+
	6	6	acf	+	-	+	-	-	+	+
	13	7	cde	-	-	+	+	+	-	+
	12	8	abd	+	+	-	+	-	-	+
2	11	1	bde	-	+	-	+	+	-	-
	10	2	adef	+	-	-	+	+	+	-
	5	3	cef	-	-	+	-	+	+	-
	1	4	(-1)	-	-	-	-	-	-	-
	15	5	bcdf	-	+	+	+	-	+	-
	14	6	acd	+	-	+	+	-	-	-
	8	7	abce	+	+	+	-	+	-	-
	4	8	abf	+	+	-	-	-	+	-

- 2_{IV}^{6-2}: resolution IV fractional factorial design
- Stove-to-stove is blocked and confounded with ABD
- Generators are $E = ABC$ and $F = BCD$

Alias Structure

Complete Defining Relation:

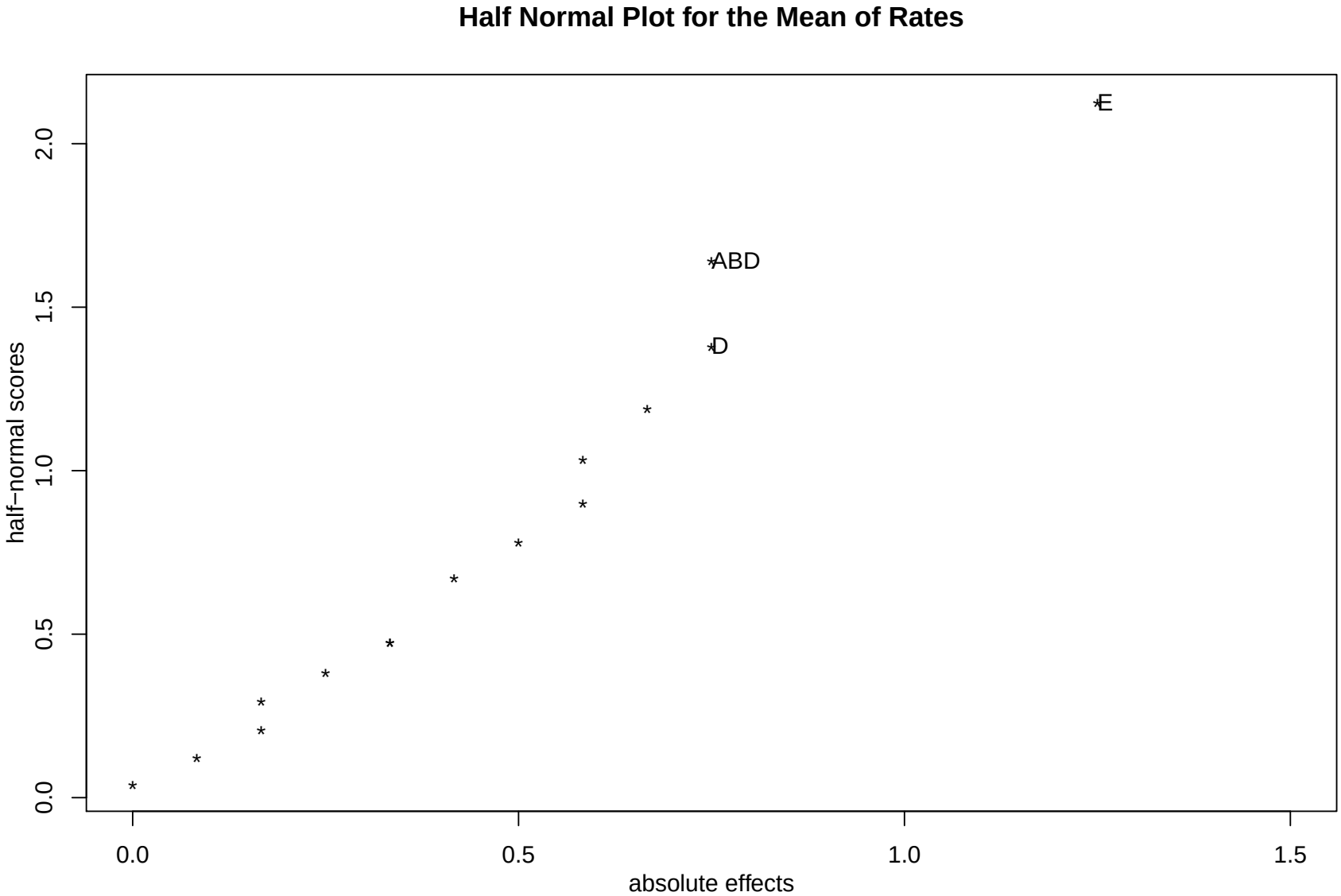
$$I = ABCE = BCDF = ADEF$$

Alias Chains:

$$A = BCE = DEF \qquad AB = CE$$
$$B = ACE = CDF \qquad AC = BE$$
$$C = ABE = BDF \qquad AD = EF$$
$$D = BCF = AEF \qquad AE = BC = DF$$
$$E = ABC = ADF \qquad AF = DE$$
$$F = BCD = ADE \qquad BD = CF$$
$$ABD = CDE = ACF = BEF \qquad BF = CD$$
$$ACD = BDE = ABF = CEF$$

ABD is confounded with the blocks and aliased with $ABD = CDE = ACF = BEF$

Daniel's Plot



The Daniel's plot shows that D, E, and ABD (block) are significant. Hence, the other factors could be screend out.

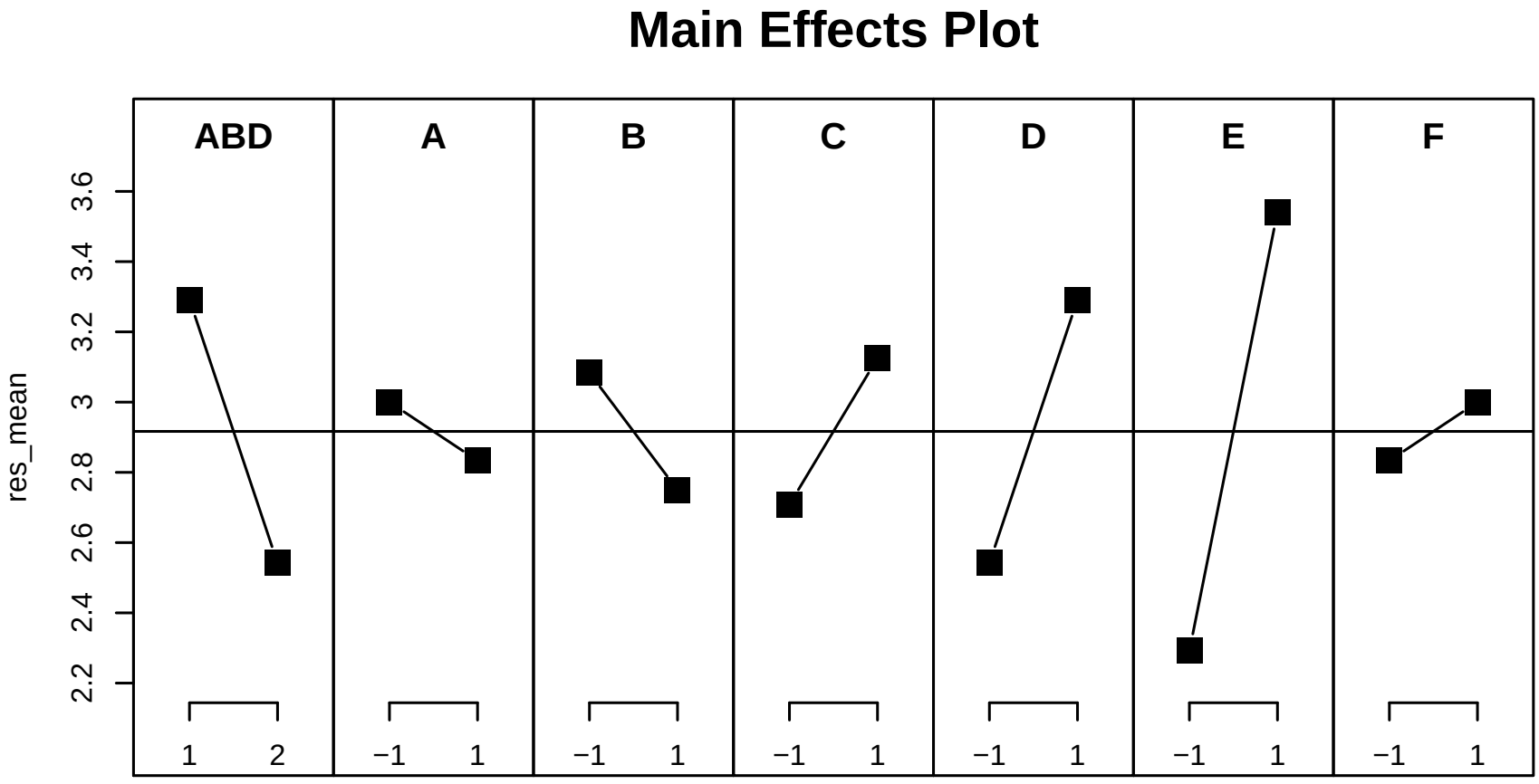
ANOVA

If we run ANOVA only for D, E, and ABD:

```
## $coefficients
##                Estimate Std. Error t value   Pr(>|t|)
## (Intercept)  2.91667    0.19341 15.0806 1.0771e-08
## ABD1        -0.37501    0.19341 -1.9390 7.8579e-02
## D1           0.37499    0.19341  1.9389 7.8588e-02
## E1           0.62501    0.19341  3.2316 7.9926e-03
## D1:E1       -0.24999    0.19341 -1.2926 2.2264e-01
```

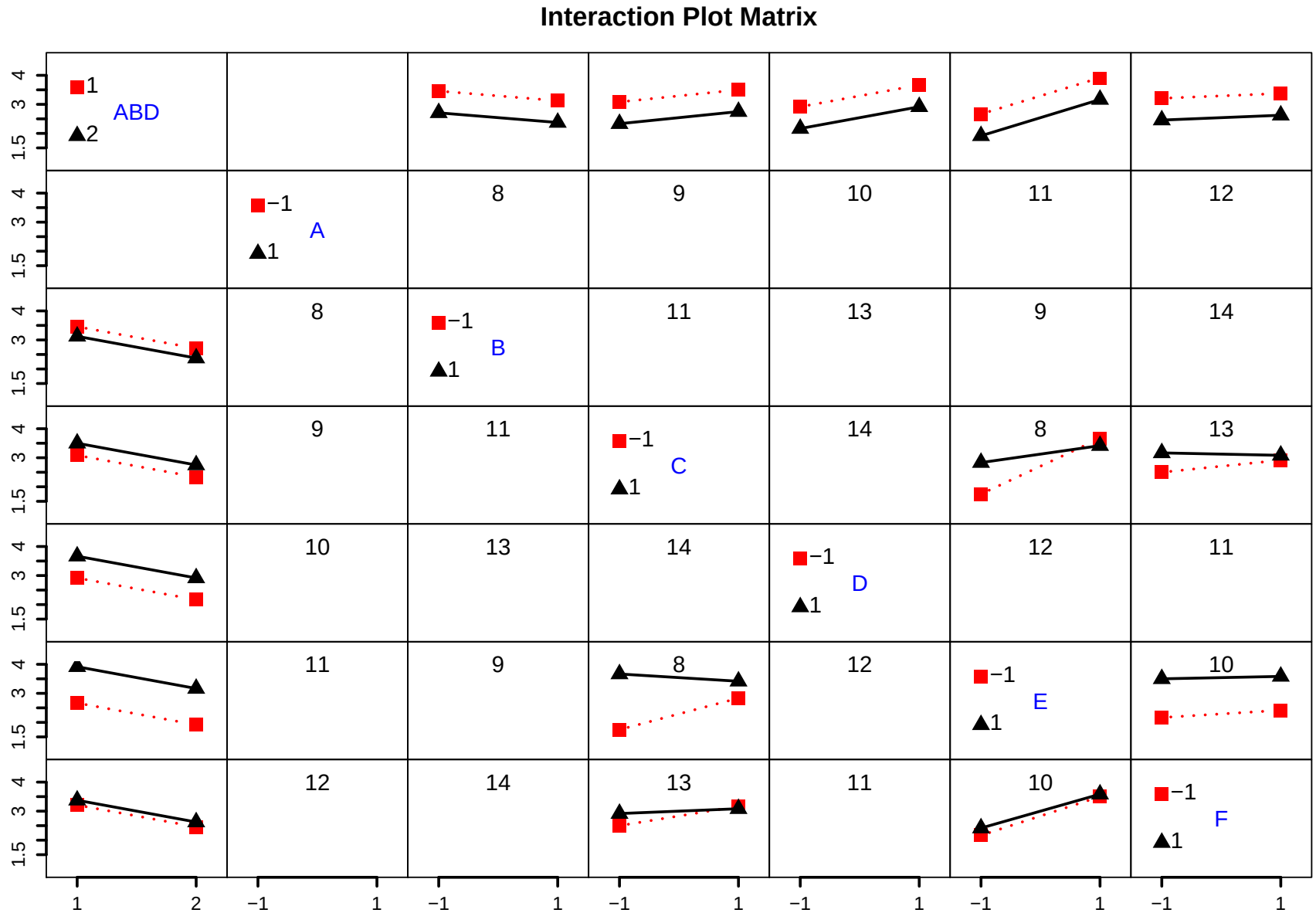
Therefore, among the three effects, only E is statistically significant. The Daniel's plot also implies the same result since only E is significantly deviates from the normal plot.

Main Effect Plots



By investigating the main effect plot, we can confirm that D, E, and ABD have larger impact than other effects. In contrast to my first conjecture, adding olive oil (A) and chicken stock B decrease the mean rate.

Interaction Plots



Two factors interaction plots imply that most of factors are independent because they are almost parallel.

Conclusion

My guess before the experiment was that olive oil and chicken stock may have significant effect on the rates, and they may have interaction between washing noodles after cooking because that might wash out the oil and the flavor of broth. *However, it turns out that stove temperature and amount of salt are more important than them, and I find out the pasta noodle brand that fits to the tast of Koreans (all testers were Koreans)*.

Suggested recipe

- Buy Dreamfields Angel Hair noodles
- Cooking noodles with the highest stove temperature
- Add 5g of salt (I know how much it is approximately without scalers)
- *Do not bother to add olive oil and chicken stock!!*

Picture of me and cooked noodles

Picture of ingredients