

# IE 511 DOE Term Project

Cook Pasta Simply

Haedong Kim

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	Barilla White Fiber	Dreamfields Angel Hair	With similar prices and types
Wash with cool water	With running tap water	None	After cooking noodles

- ▶ I chose ingredients that I can find easily in the nearest grocery store from my home (Giant)
- ▶ 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 minutes
- ▶ 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	bcd	-	+	+	+	-	+	-
	14	6	acd	+	-	+	+	-	-	-
	8	7	abce	+	+	+	-	+	-	-
	4	8	abf	+	+	-	-	-	+	-

- ▶  $2_{IV}^{6-2}$ : resolution *IV* fractional factorial design
- ▶ Stove-to-stove is a nuisance factor, so it is blocked by using two different stoves as blocks
- ▶ The standard order in the second column of the table is the

# Alias Structure

## Complete Defining Relation:

$$I = ABCE = BCDF = ADEF$$

## Alias Chains:

$$A = BCE = DEF$$

$$AB = CE$$

$$B = ACE = CDF$$

$$AC = BE$$

$$C = ABE = BDF$$

$$AD = EF$$

$$D = BCF = AEF$$

$$AE = BC = DF$$

$$E = ABC = ADF$$

$$AF = DE$$

$$F = BCD = ADE$$

$$BD = CF$$

$$ABD = CDE = ACF = BEF$$

$$BF = CD$$

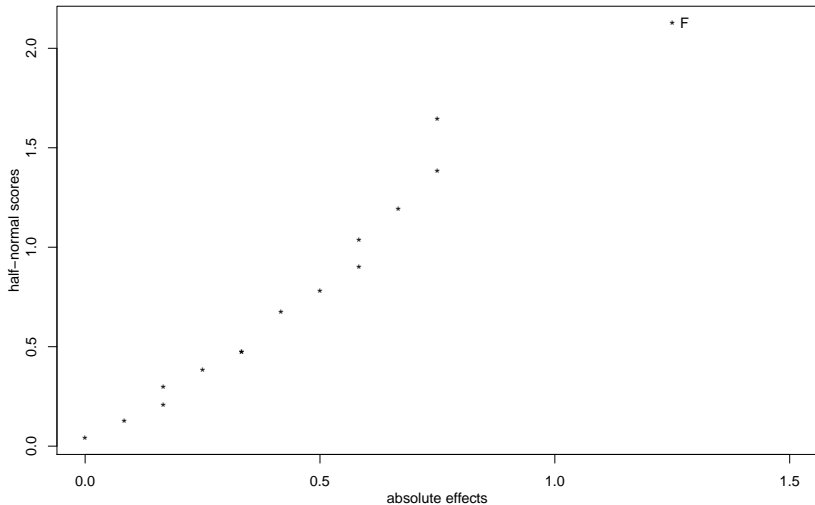
$$ACD = BDE = ABF = CEF$$

*ABD* is confounded with the blocks and aliased with

$$ABD = CDE = ACF = BEF$$

# Daniel's Plot

Half Normal Plot for res\_mean, alpha=0.1

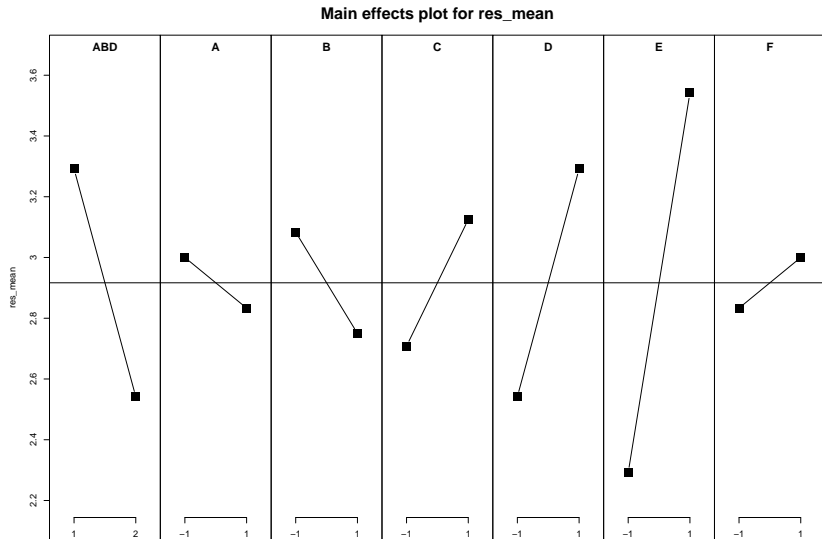


A = ABD , B = A , C = B , D = C , E = D , F = E , G = F

# ANOVA

```
## Number of observations used: 16
## Formula:
## res_mean ~ ABD + (A + B + C + D + E + F)^2
##
## Call:
## lm.default(formula = fo, data = model.frame(fo, data = 1
##
## Residuals:
##          1          2          3          4          5
## 6.25e-06  6.25e-06 -6.25e-06 -6.25e-06 -6.25e-06 -6.25e-06
##          8          9         10         11         12
## 6.25e-06  6.25e-06  6.25e-06 -6.25e-06 -6.25e-06  6.25e-06
##        15        16
## 6.25e-06 -6.25e-06
##
## Coefficients: (8 not defined because of singularities)
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)  2.917e+00  6.250e-06  466667 1.36e-06 ***
```

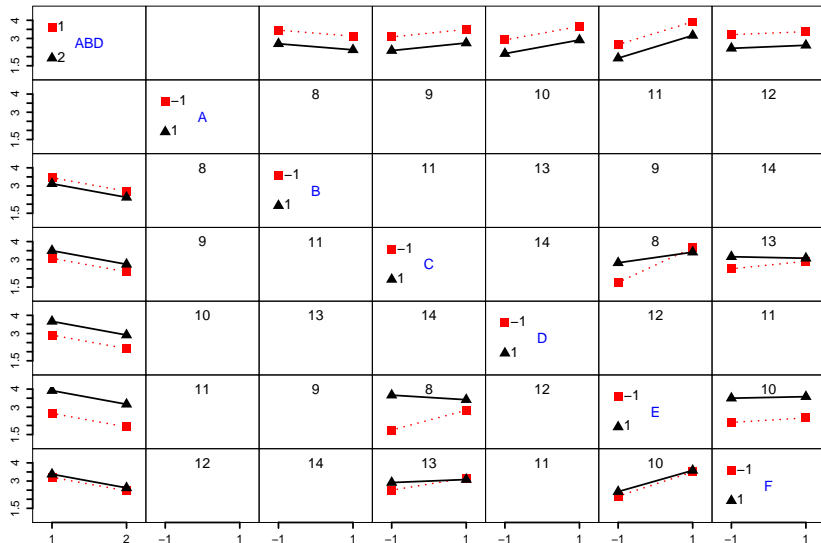
# Main Effect Plots





# Interaction Plots

Interaction plot matrix for res\_mean



# Conclusion

- ▶ Important effects are

Picture of me and cooked noodles



## Picture of ingredients

