

MLR Model

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Imports and Constants

```
library("tidyverse")
source('./gibbs_util.R')
```

```
RANDOM_SEED = 440
```

Data Loading / Cleaning

```
load('./burritodata.Rda')
head(burrito)
```

```
##           Location Cost Hunger Length Circum Volume Tortilla Temp Meat
## 1  Donato's taco shop 6.49   3.0    NA     NA      NA       3  5.0  3.0
## 2  Oscar's Mexican food 5.45   3.5    NA     NA      NA       2  3.5  2.5
## 3  Oscar's Mexican food 4.85   1.5    NA     NA      NA       3  2.0  2.5
## 4  Oscar's Mexican food 5.25   2.0    NA     NA      NA       3  2.0  3.5
## 5      Pollos Maria 6.59   4.0    NA     NA      NA       4  5.0  4.0
## 6      Pollos Maria 6.99   4.0    NA     NA      NA       3  4.0  5.0
##  Fillings Meat_filling Uniformity Salsa Synergy Wrap Reviewer overall Beef
## 1      3.5          4.0          4.0  4.0    4.0    4    Scott    3.80    1
## 2      2.5          2.0          4.0  3.5    2.5    5    Scott    3.00    1
## 3      3.0          4.5          4.0  3.0    3.0    5    Emily    3.00    0
## 4      3.0          4.0          5.0  4.0    4.0    5    Ricardo  3.75    1
## 5      3.5          4.5          5.0  2.5    4.5    4    Scott    4.20    1
## 6      3.5          2.5          2.5  2.5    4.0    1    Emily    3.20    0
##  Pico Guac Cheese Fries Sour_cream Pork Chicken Shrimp Fish Rice Beans Lettuce
## 1    1    1    1    1          0    0          0    0    0    0    0    0
## 2    1    1    1    1          0    0          0    0    0    0    0    0
## 3    1    1    0    0          0    1          0    0    0    0    0    0
## 4    1    1    0    0          0    0          0    0    0    0    0    0
## 5    1    0    1    1          0    0          0    0    0    0    0    0
## 6    0    1    1    0          1    0          1    0    0    1    1    1
##  Tomato Bell_peper Carrots Cabbage Sauce Cilantro Onion Taquito Pineapple Ham
## 1      0          0          0          0    0          0    0    0          0    0    0
## 2      0          0          0          0    0          0    0    0          0    0    0
```

```
## 3      0      0      0      0      0      0      0      0      0      0
## 4      0      0      0      0      0      0      0      0      0      0
## 5      0      0      0      0      0      0      0      0      0      0
## 6      1      0      0      0      0      0      0      0      0      0
##   Chile_relleno Nopales Lobster Egg Mushroom Bacon Sushi Avocado Corn Zucchini
## 1              0      0      0  0      0      0      0      0      0      0
## 2              0      0      0  0      0      0      0      0      0      0
## 3              0      0      0  0      0      0      0      0      0      0
## 4              0      0      0  0      0      0      0      0      0      0
## 5              0      0      0  0      0      0      0      0      0      0
## 6              0      0      0  0      0      0      0      0      0      0
```

```
# Count Remove NA Cost rows
which(is.na(burrito$Cost))
```

```
## [1] 113 135
```

```
burrito = burrito[!is.na(burrito$Cost),]
nrow(burrito)
```

```
## [1] 237
```

```
burrito<-burrito%>%mutate(Vegetable=as.logical(Pineapple+Bell_peper+Tomato+
      Cabbage+Mushroom+Corn+
      Carrots+Zucchini))
burrito<-burrito%>%mutate(Breakfast=as.logical(Egg+Bacon+Ham))
burrito<-burrito%>%mutate(Other=as.logical(Fish+Taquito+Chile_relleno+
      Nopales+Sushi+Lobster))
burrito<-select(burrito, -c('Pineapple', 'Bell_peper', 'Tomato', 'Cabbage',
      'Mushroom', 'Corn', 'Carrots', 'Zucchini',
      'Egg', 'Ham', 'Fish', 'Taquito', 'Chile_relleno',
      'Nopales', 'Sushi', 'Lobster', 'Bacon'))
burrito<-burrito%>%mutate_at(c('Vegetable','Other','Breakfast'),as.double)
head(burrito)
```

```
##           Location Cost Hunger Length Circum Volume Tortilla Temp Meat
## 1  Donato's taco shop 6.49   3.0    NA     NA     NA       3  5.0  3.0
## 2  Oscar's Mexican food 5.45   3.5    NA     NA     NA       2  3.5  2.5
## 3  Oscar's Mexican food 4.85   1.5    NA     NA     NA       3  2.0  2.5
## 4  Oscar's Mexican food 5.25   2.0    NA     NA     NA       3  2.0  3.5
## 5      Pollos Maria 6.59   4.0    NA     NA     NA       4  5.0  4.0
## 6      Pollos Maria 6.99   4.0    NA     NA     NA       3  4.0  5.0
##   Fillings Meat_filling Uniformity Salsa Synergy Wrap Reviewer overall Beef
## 1      3.5           4.0         4.0  4.0   4.0   4   Scott   3.80    1
## 2      2.5           2.0         4.0  3.5   2.5   5   Scott   3.00    1
## 3      3.0           4.5         4.0  3.0   3.0   5   Emily   3.00    0
## 4      3.0           4.0         5.0  4.0   4.0   5  Ricardo   3.75    1
## 5      3.5           4.5         5.0  2.5   4.5   4   Scott   4.20    1
## 6      3.5           2.5         2.5  2.5   4.0   1   Emily   3.20    0
##   Pico Guac Cheese Fries Sour_cream Pork Chicken Shrimp Rice Beans Lettuce
## 1    1    1    1    1         0    0         0    0    0    0    0
## 2    1    1    1    1         0    0         0    0    0    0    0
```

```
## 3    1    1    0    0    0    1    0    0    0    0    0
## 4    1    1    0    0    0    0    0    0    0    0    0
## 5    1    0    1    1    0    0    0    0    0    0    0
## 6    0    1    1    0    1    0    1    0    1    1    1
##      Sauce Cilantro Onion Avocado Vegetable Breakfast Other
## 1      0      0      0      0      0      0      0      0
## 2      0      0      0      0      0      0      0      0
## 3      0      0      0      0      0      0      0      0
## 4      0      0      0      0      0      0      0      0
## 5      0      0      0      0      0      0      0      0
## 6      0      0      0      0      1      0      0      0
```

```
ingredient_cols = colnames(burrito)[18:36]

ingredient_X = as.matrix(burrito[ingredient_cols])
dim(ingredient_X); head(ingredient_X)
```

```
## [1] 237 19
```

```
##      Beef Pico Guac Cheese Fries Sour_cream Pork Chicken Shrimp Rice Beans
## [1,]    1    1    1    1    1    0    0    0    0    0    0
## [2,]    1    1    1    1    1    0    0    0    0    0    0
## [3,]    0    1    1    0    0    0    1    0    0    0    0
## [4,]    1    1    1    0    0    0    0    0    0    0    0
## [5,]    1    1    0    1    1    0    0    0    0    0    0
## [6,]    0    0    1    1    0    1    0    1    0    1    1
##      Lettuce Sauce Cilantro Onion Avocado Vegetable Breakfast Other
## [1,]      0      0      0      0      0      0      0      0
## [2,]      0      0      0      0      0      0      0      0
## [3,]      0      0      0      0      0      0      0      0
## [4,]      0      0      0      0      0      0      0      0
## [5,]      0      0      0      0      0      0      0      0
## [6,]      1      0      0      0      0      1      0      0
```

```
cost_y = burrito$Cost
length(cost_y); head(cost_y)
```

```
## [1] 237
```

```
## [1] 6.49 5.45 4.85 5.25 6.59 6.99
```

Model Fit with Gibbs Sampler

```
set.seed(RANDOM_SEED)

p = ncol(ingredient_X) + 1
tau_2 = 4
prior_sigma = 1.5
a = 1 / (prior_sigma^4)
```

```

b = 1 / (prior_sigma^2)

mlr_post_dist = mlr_gibbs(ingredient_X, cost_y, mu=rep(0, p), tau_2, a, b)
mlr_post_dist = mlr_post_dist[5001:1000, ]
summarize_dist(mlr_post_dist, colnames(mlr_post_dist), round_places=2)

```

| Parameter | Post. Mean | Post. Sd | 95% CI Low | 95% CI High |
|------------|------------|----------|------------|-------------|
| Intercept | 6.41 | 0.20 | 6.02 | 6.80 |
| Beef | 0.16 | 0.30 | -0.42 | 0.75 |
| Pico | -0.09 | 0.20 | -0.47 | 0.31 |
| Guac | 0.19 | 0.20 | -0.20 | 0.57 |
| Cheese | -0.17 | 0.25 | -0.66 | 0.31 |
| Fries | 0.29 | 0.24 | -0.19 | 0.75 |
| Sour_cream | 0.34 | 0.21 | -0.06 | 0.75 |
| Pork | 0.16 | 0.33 | -0.49 | 0.81 |
| Chicken | 0.47 | 0.38 | -0.27 | 1.24 |
| Shrimp | 1.60 | 0.46 | 0.69 | 2.50 |
| Rice | 0.00 | 0.28 | -0.55 | 0.54 |
| Beans | -0.45 | 0.28 | -0.99 | 0.11 |
| Lettuce | 0.18 | 0.41 | -0.60 | 0.98 |
| Sauce | 0.17 | 0.31 | -0.44 | 0.77 |
| Cilantro | -0.17 | 0.82 | -1.77 | 1.39 |
| Onion | -0.05 | 0.78 | -1.58 | 1.47 |
| Avocado | -0.03 | 0.56 | -1.12 | 1.09 |
| Vegetable | 0.21 | 0.28 | -0.35 | 0.75 |
| Breakfast | -0.32 | 0.54 | -1.36 | 0.75 |
| Other | 1.30 | 0.31 | 0.69 | 1.91 |
| sigma | 1.15 | 0.05 | 1.05 | 1.26 |

This model won't work for us because it fits prices to be negative. Instead, why don't we use a truncated Gibbs sampler.

Truncated Gibbs

```

set.seed(RANDOM_SEED)

truncated_post_dist<-truncated_gibbs(ingredient_X, cost_y, mu=rep(1, p),
                                     tau_2, a, b, lb=rep(0,p), ub=rep(Inf,p))
truncated_post_dist = truncated_post_dist[5001:1000, ]

```

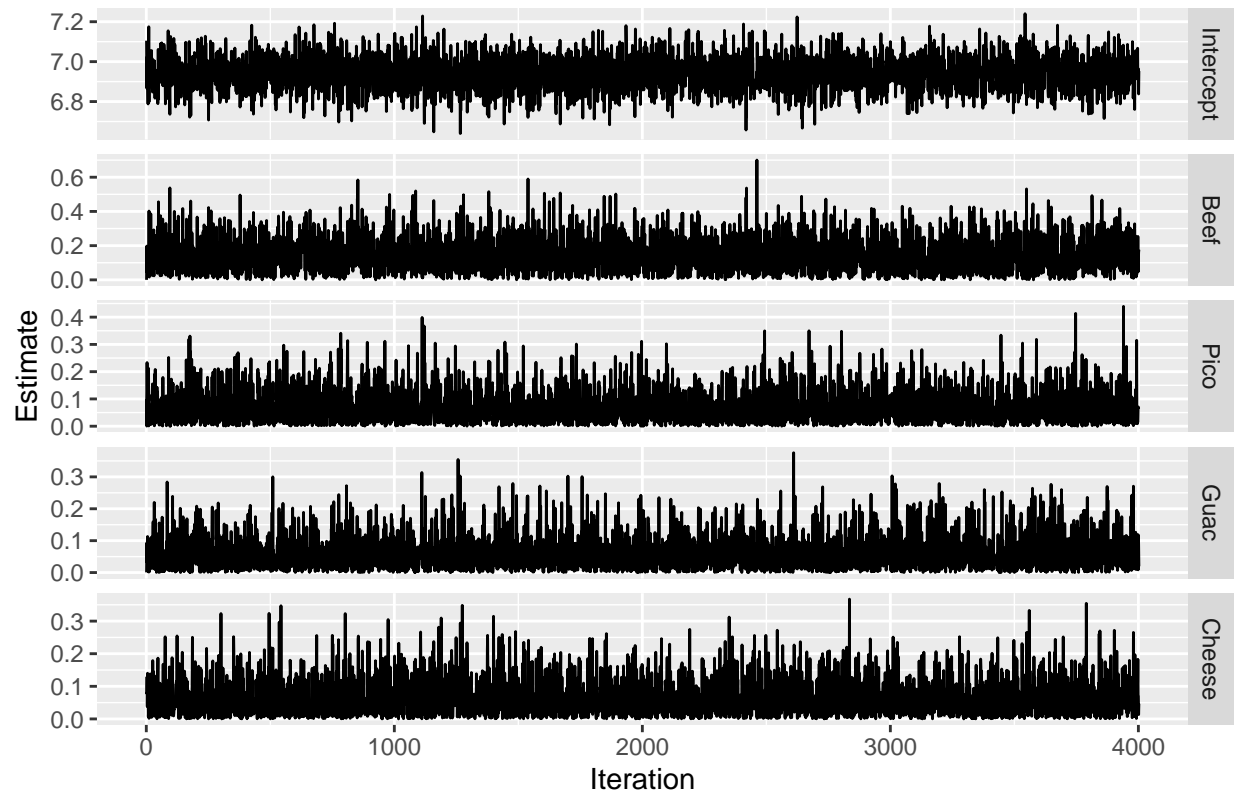
Model Diagnostics

```

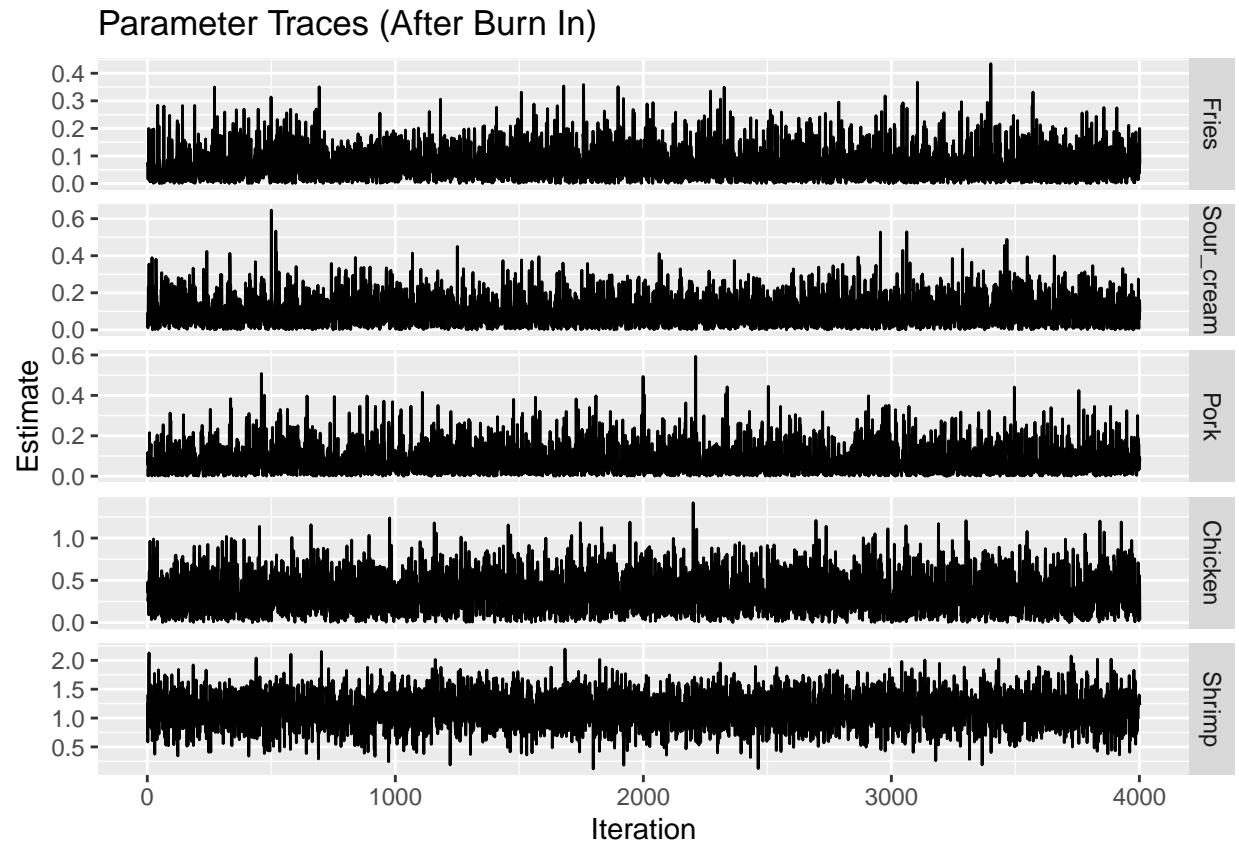
plot_traces(truncated_post_dist[,1:5], 'Parameter Traces (After Burn In)')

```

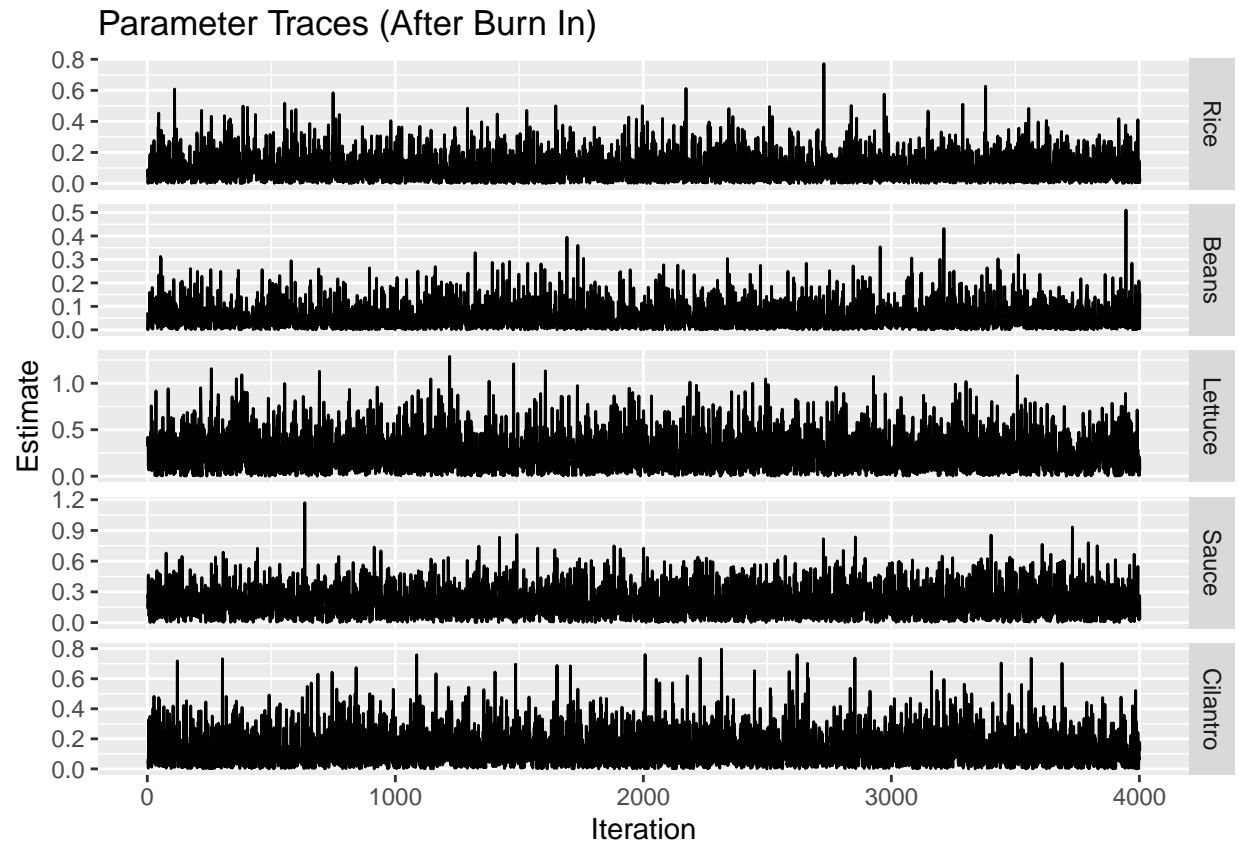
Parameter Traces (After Burn In)



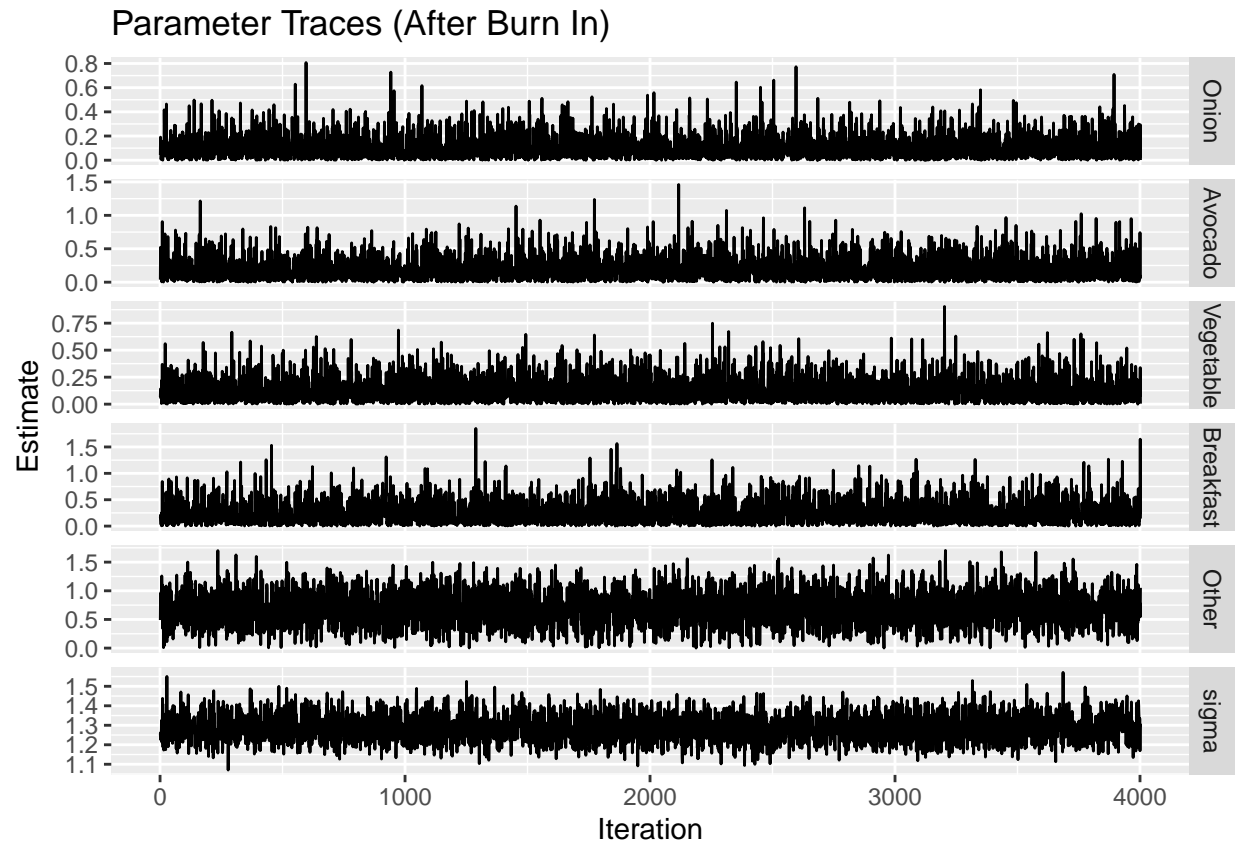
```
plot_traces(truncated_post_dist[,6:10], 'Parameter Traces (After Burn In)')
```



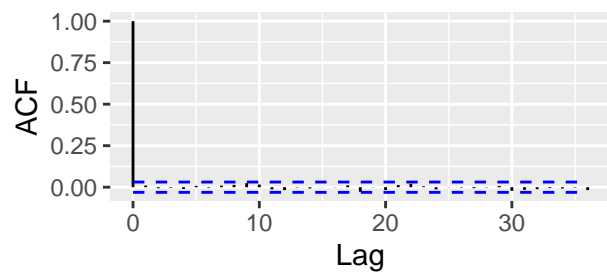
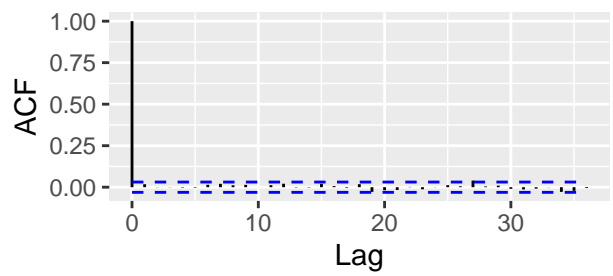
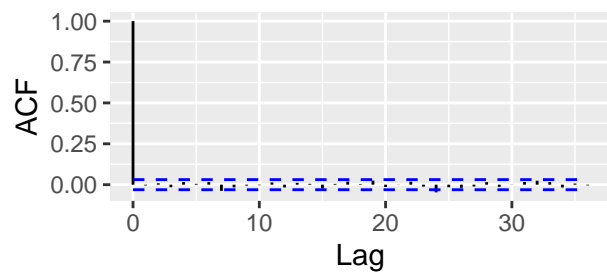
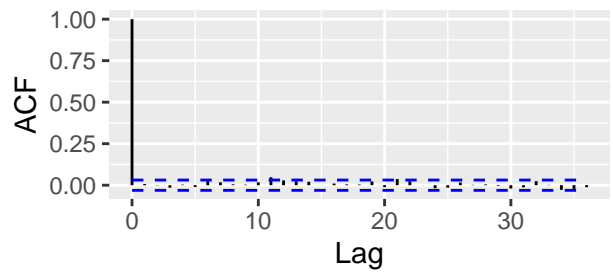
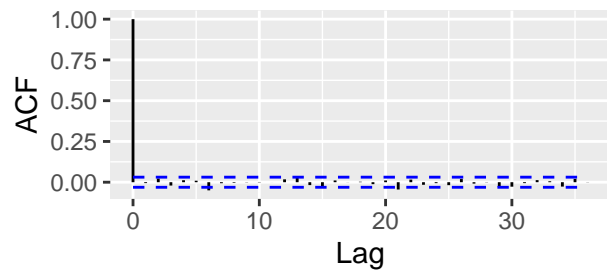
```
plot_traces(truncated_post_dist[:,11:15], 'Parameter Traces (After Burn In)')
```



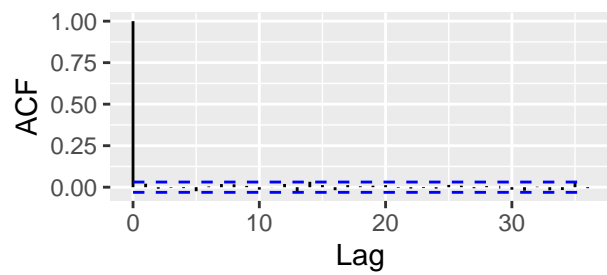
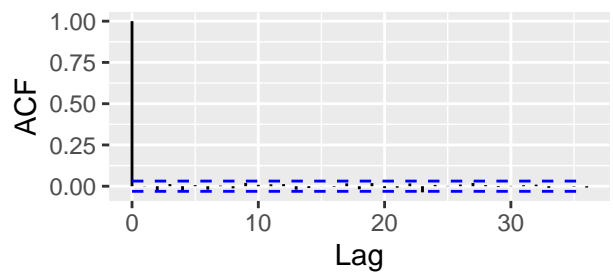
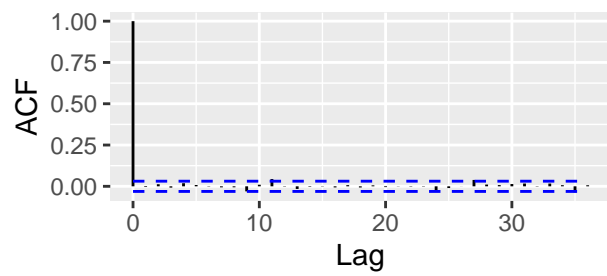
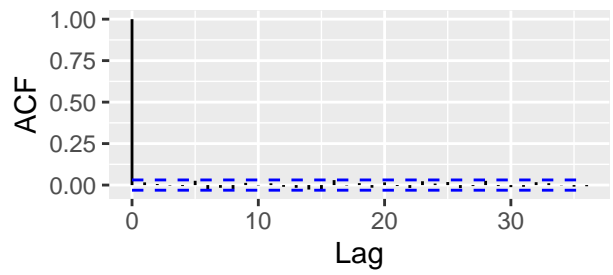
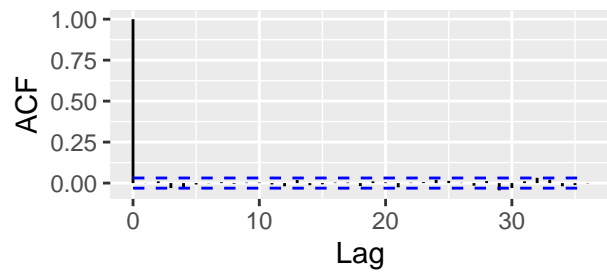
```
plot_traces(truncated_post_dist[:,16:21], 'Parameter Traces (After Burn In)')
```



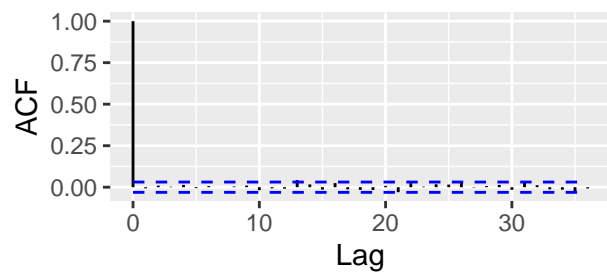
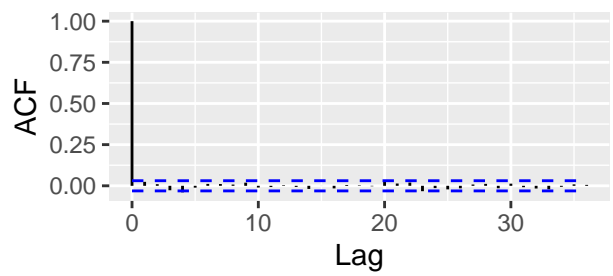
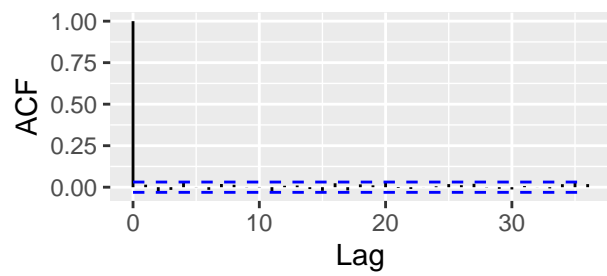
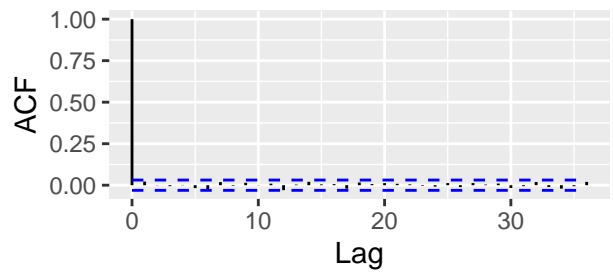
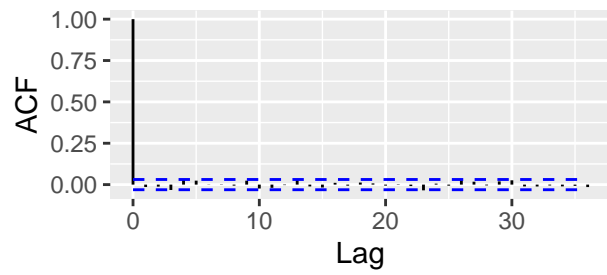
```
acf_plots(truncated_post_dist[,1:5])
```

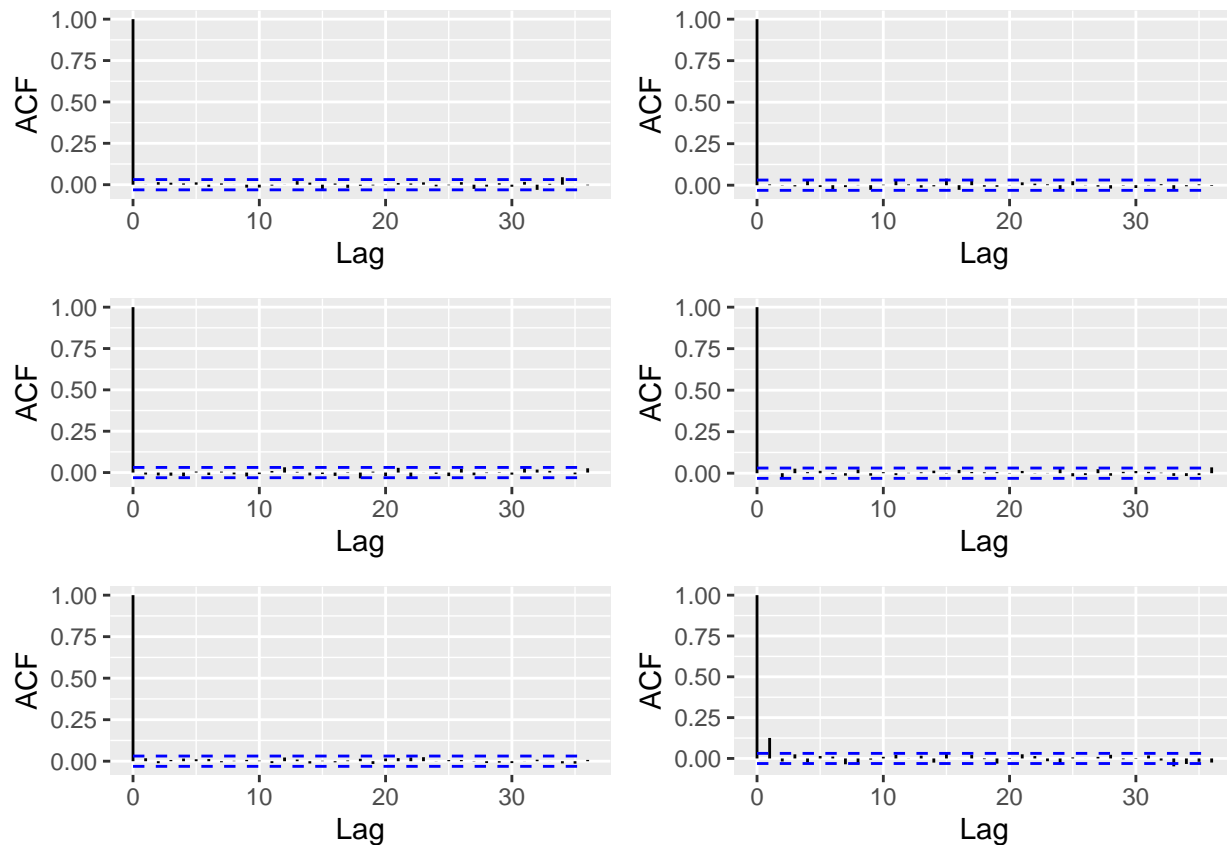
```
acf_plots(truncated_post_dist[,6:10])
```



```
acf_plots(truncated_post_dist[,11:15])
```



```
acf_plots(truncated_post_dist[,16:21])
```



```
summarize_dist(truncated_post_dist, colnames(truncated_post_dist), round_places=2)
```

| Parameter | Post. Mean | Post. Sd | 95% CI Low | 95% CI High |
|------------|------------|----------|------------|-------------|
| Intercept | 6.94 | 0.08 | 6.78 | 7.11 |
| Beef | 0.15 | 0.10 | 0.01 | 0.37 |
| Pico | 0.07 | 0.06 | 0.00 | 0.23 |
| Guac | 0.06 | 0.05 | 0.00 | 0.20 |
| Cheese | 0.06 | 0.06 | 0.00 | 0.21 |
| Fries | 0.07 | 0.06 | 0.00 | 0.22 |
| Sour_cream | 0.10 | 0.08 | 0.00 | 0.30 |
| Pork | 0.08 | 0.07 | 0.00 | 0.28 |
| Chicken | 0.35 | 0.23 | 0.02 | 0.87 |
| Shrimp | 1.14 | 0.30 | 0.55 | 1.73 |
| Rice | 0.10 | 0.09 | 0.00 | 0.33 |
| Beans | 0.06 | 0.06 | 0.00 | 0.21 |
| Lettuce | 0.25 | 0.20 | 0.01 | 0.77 |
| Sauce | 0.20 | 0.15 | 0.01 | 0.57 |
| Cilantro | 0.14 | 0.12 | 0.00 | 0.44 |
| Onion | 0.11 | 0.10 | 0.00 | 0.37 |
| Avocado | 0.20 | 0.18 | 0.01 | 0.65 |
| Vegetable | 0.13 | 0.11 | 0.00 | 0.42 |
| Breakfast | 0.25 | 0.22 | 0.01 | 0.83 |
| Other | 0.69 | 0.30 | 0.13 | 1.28 |
| sigma | 1.28 | 0.07 | 1.16 | 1.42 |

Model Interpretations