MLR Model

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Imports and Constants

```
library("tidyverse")
```

```
## -- Attaching packages ---------------------------------------------------------------------------------- t
```

```
## v ggplot2 3.3.2     v purrr   0.3.4
## v tibble  3.0.3     v dplyr   1.0.2
## v tidyr   1.1.2     v stringr 1.4.0
## v readr   1.3.1     v forcats 0.5.0
```

```
## -- Conflicts ------------------------------------------------------------------------------------- tidyvers
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()    masks stats::lag()
```

```
source('./gibbs_util.R')
```

```
##
## Attaching package: 'pracma'
```

```
## The following object is masked from 'package:purrr':
##
##     cross
```

```
## Loading required package: reshape2
```

```
##
## Attaching package: 'reshape2'
```

```
## The following object is masked from 'package:tidyr':
##
##     smiths
```

```
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
## 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      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
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','Zu
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 Bacon 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       0         1         0     0
```

```
ingredient_cols = colnames(burrito)[18:37]

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

```
## [1] 237  20
```

```
##      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 Bacon Avocado Vegetable Breakfast Other
## [1,]       0     0        0     0     0       0         0         0     0
## [2,]       0     0        0     0     0       0         0         0     0
## [3,]       0     0        0     0     0       0         0         0     0
```

```
## [4,]       0     0        0     0     0       0        0         0     0
## [5,]       0     0        0     0     0       0        0         0     0
## [6,]       1     0        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

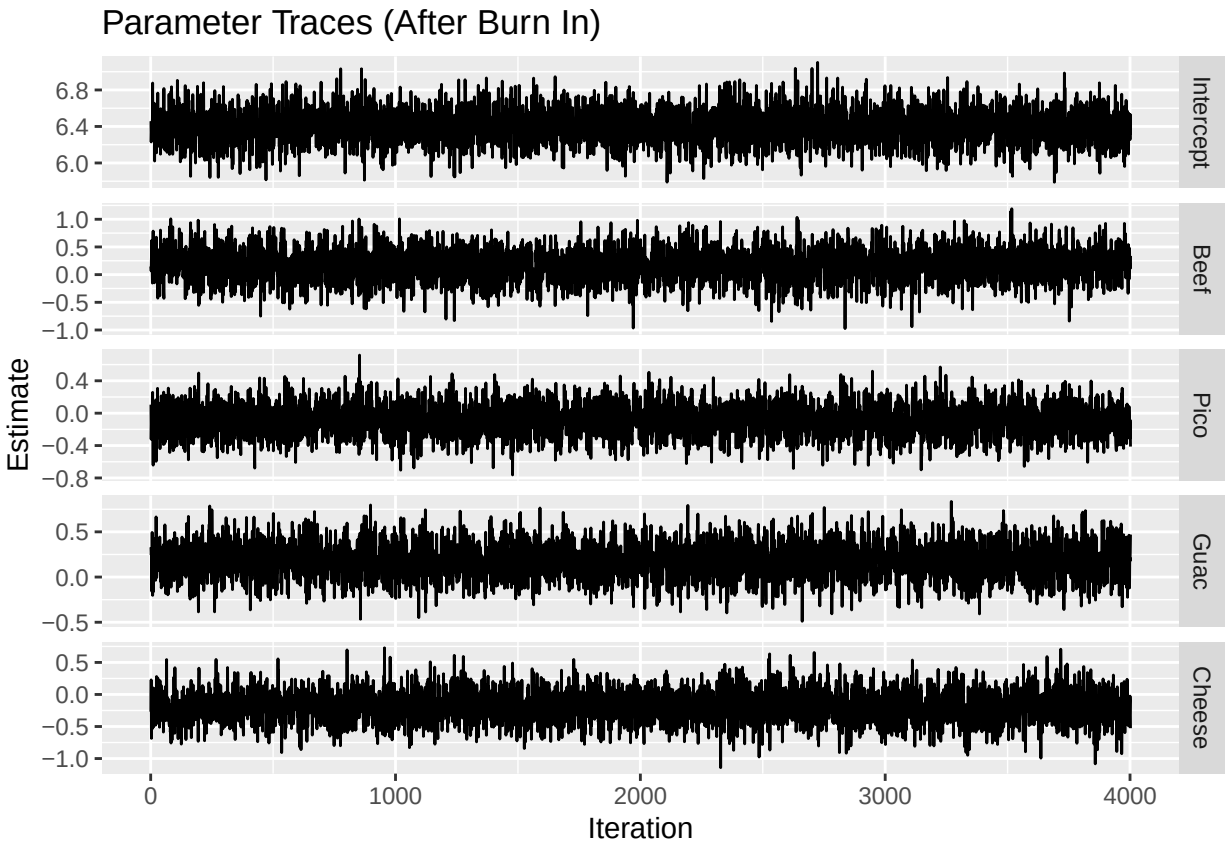
```
set.seed(RANDOM_SEED)

p = ncol(ingredient_X) + 1
tau_2 = 4
prior_sigma = 1.5
a = 1 / (prior_sigma^4)
b = 1 / (prior_sigma^2)

post_dist = mlr_gibbs(ingredient_X, cost_y, mu=rep(0, p), tau_2, a, b)
post_dist = post_dist[5001:1000, ]
head(post_dist)
```

```
##      Intercept       Beef        Pico       Guac     Cheese      Fries
## [1,]  6.457323 0.14732084  0.10498064  0.3292975 -0.2687287 0.07278756
## [2,]  6.230226 0.06600002 -0.32106258  0.2469540  0.2267794 0.30107685
## [3,]  6.337929 0.32886158 -0.12912433  0.2607176 -0.6843773 0.72381129
## [4,]  6.270581 0.61552338 -0.11429203  0.1452726 -0.3716379 0.15098337
## [5,]  6.382961 0.38377479  0.03512385 -0.1591162 -0.1348034 0.14152734
## [6,]  6.409782 0.16454399 -0.22361254  0.4933260  0.1153033 0.17706473
##      Sour_cream        Pork     Chicken    Shrimp        Rice      Beans
## [1,]  0.6005529  0.10435494  0.38171132 1.3362527 -0.30623467 -0.3977458
## [2,]  0.3924969  0.65234797  0.32672399 1.5144784 -0.03185142 -0.5693427
## [3,]  0.1409256 -0.02688308  0.95340142 1.3045827  0.14504859 -0.2310543
## [4,]  0.5427439  0.17205256 -0.07227909 0.6228603  0.22285072 -0.2981898
## [5,]  0.2447920  0.67862036 -0.03876074 1.3723927  0.30107326 -1.1899112
## [6,] -0.1505483 -0.07035614  0.15116520 0.5530529  0.31118019 -0.4697745
##         Lettuce       Sauce   Cilantro       Onion      Bacon     Avocado
## [1,]  0.0514829 -0.02662257 -1.2774799  1.02905652  0.3399074  0.83556669
## [2,]  0.4711304 -0.23048708  0.2321436 -0.46798069  0.2205063  0.80705995
## [3,]  0.2266287  0.17267496  0.1164244  0.09069149  1.0152561  0.07163328
## [4,] -0.2725402  0.89752720 -1.1762454  0.35839127  0.2250188  0.73497863
## [5,]  0.9923300  0.42192685 -0.2755737 -0.31124968 -0.1375917 -0.17809750
## [6,]  0.5618469 -0.21932279 -1.5656351  1.44070028  1.7297049  1.26642241
##        Vegetable  Breakfast     Other    sigma
## [1,] -0.29091587 -0.5525855 0.8586459 1.171498
## [2,]  0.53883107 -0.9508692 1.4629677 1.054488
## [3,]  0.24809310  0.1382003 1.0314996 1.066971
```

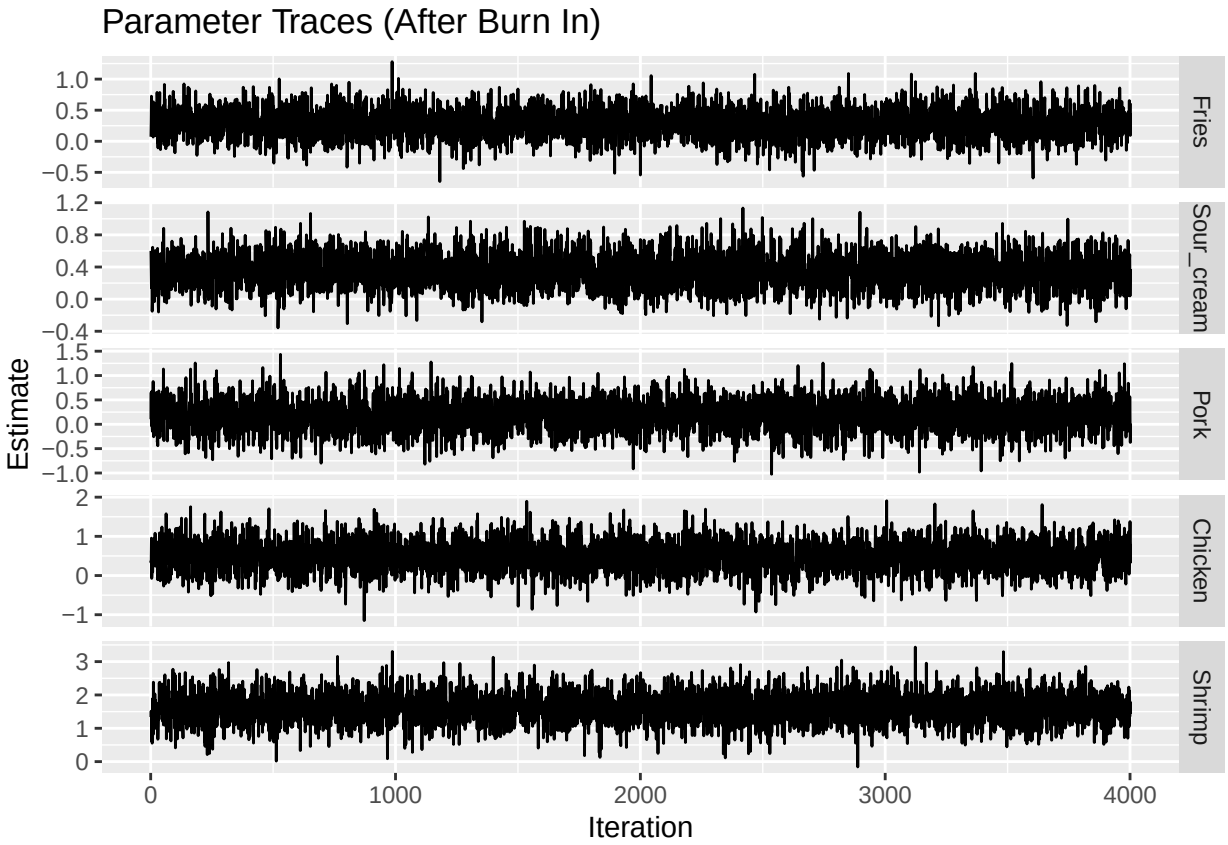
```
## [4,]  0.17801284 -0.4203790 1.0541865 1.158596
## [5,]  0.34353953 -0.4983536 1.2487876 1.218173
## [6,]  0.04511161 -1.9742351 0.9298518 1.156093
```

Model Diagnostics

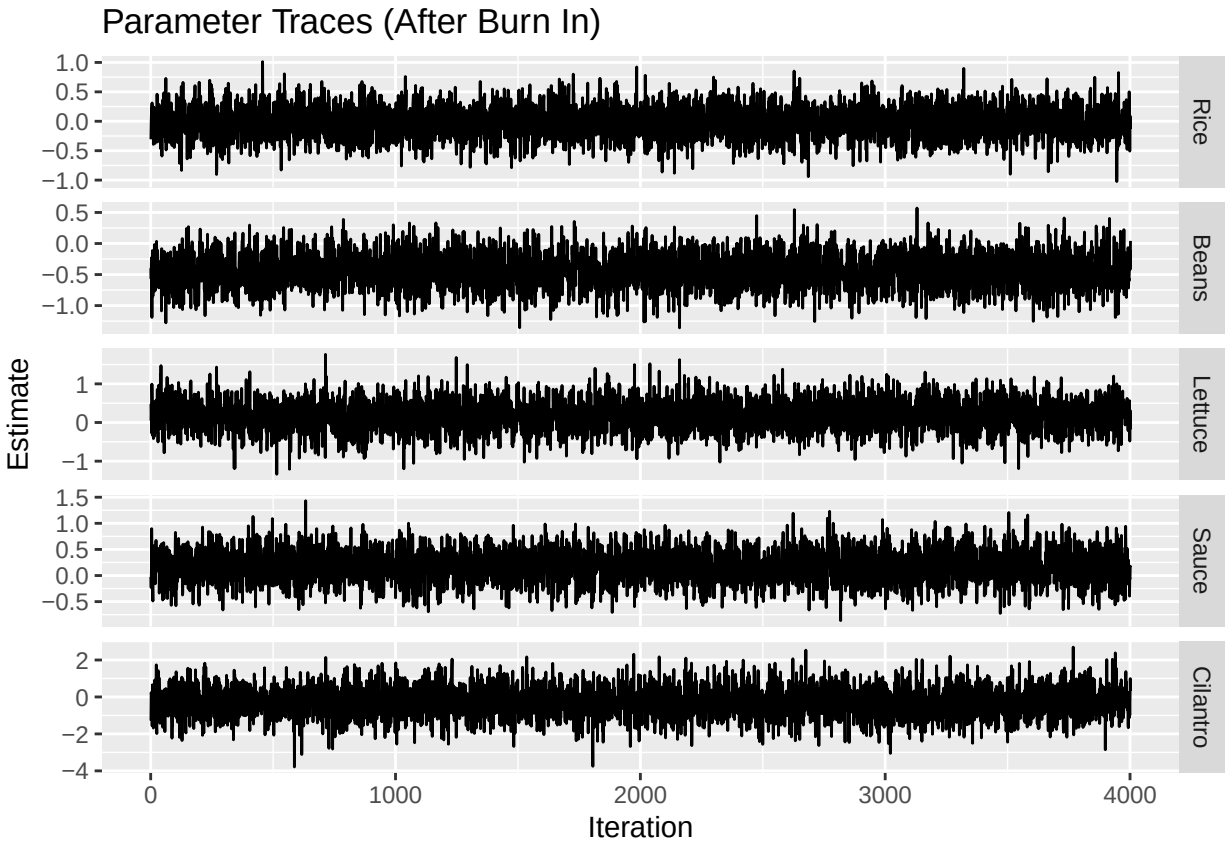
```
plot_traces(post_dist[,1:5], 'Parameter Traces (After Burn In)')
```



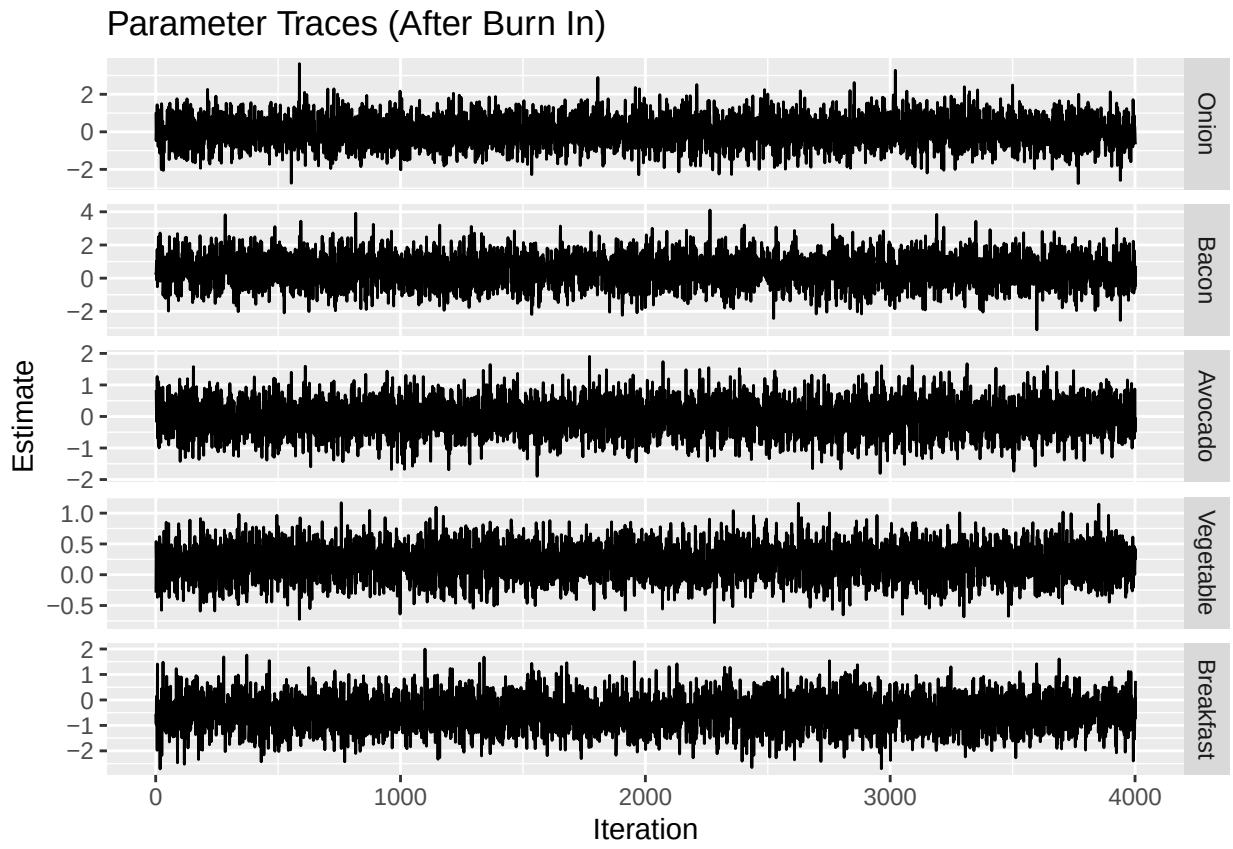

```
plot_traces(post_dist[,6:10], 'Parameter Traces (After Burn In)')
```



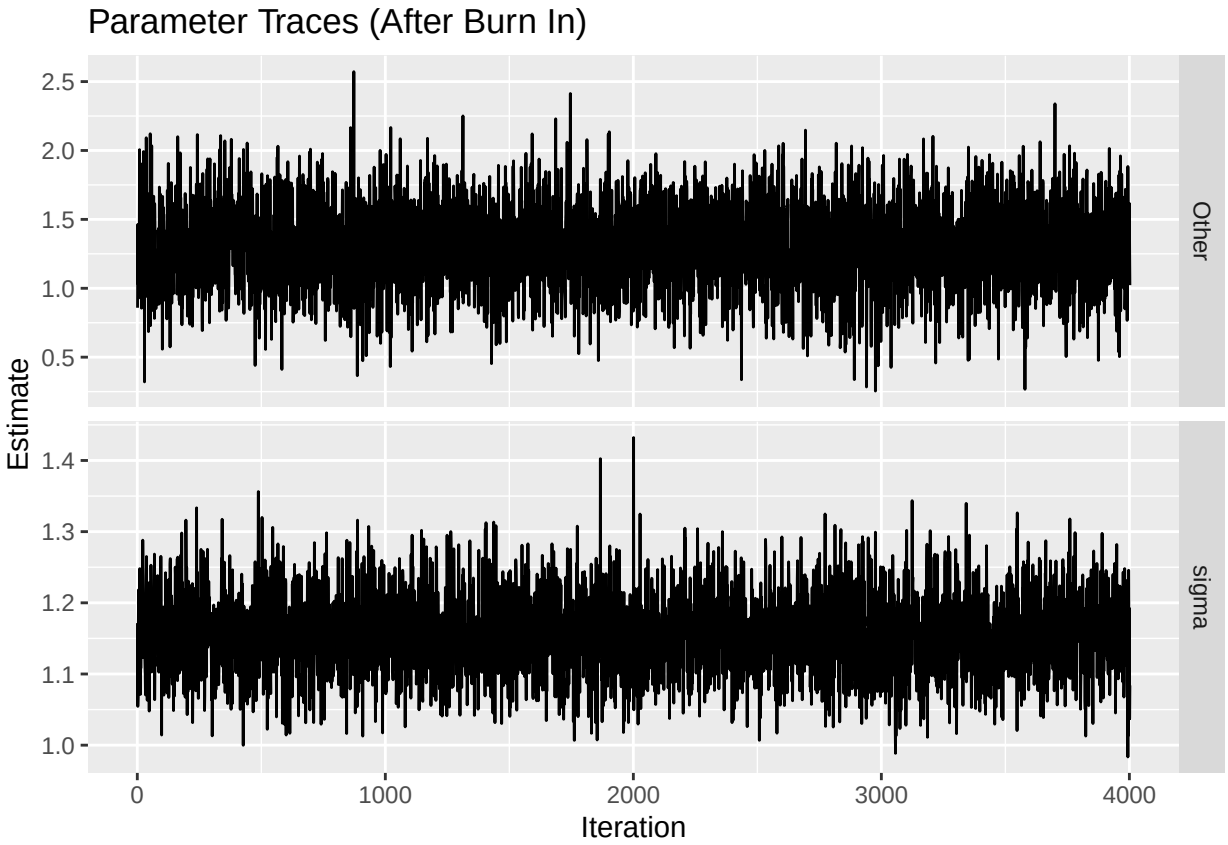

```
plot_traces(post_dist[,11:15], 'Parameter Traces (After Burn In)')
```




```
plot_traces(post_dist[,16:20], 'Parameter Traces (After Burn In)')
```




```
plot_traces(post_dist[,21:22], 'Parameter Traces (After Burn In)')
```




```
summarize_dist(post_dist, colnames(post_dist))
```

Parameter	Post. Mean	Post. Sd	95% CI Low	95% CI High
Intercept	6.4018019	0.1925394	6.0300919	6.7802210
Beef	0.1713374	0.2965908	-0.4084506	0.7565898
Pico	-0.0889503	0.1993238	-0.4712776	0.3023580
Guac	0.1828112	0.1987330	-0.2011067	0.5706622
Cheese	-0.1873992	0.2489841	-0.6794948	0.3112114
Fries	0.2930892	0.2370922	-0.1668237	0.7594959
Sour_cream	0.3467485	0.2143117	-0.0616446	0.7803448
Pork	0.1820559	0.3296050	-0.4748285	0.8220752
Chicken	0.4931122	0.3919773	-0.2858897	1.2553760
Shrimp	1.6144664	0.4566544	0.7128927	2.5349351
Rice	-0.0138185	0.2738275	-0.5461606	0.5160242
Beans	-0.4423016	0.2832106	-0.9958315	0.1122606
Lettuce	0.1806142	0.4030846	-0.6082863	0.9632470
Sauce	0.1749063	0.3140238	-0.4469121	0.7862746
Cilantro	-0.2735357	0.8311912	-1.9075545	1.3902547
Onion	0.0417970	0.7897053	-1.5060108	1.5679840
Bacon	0.4852320	0.9353513	-1.3491983	2.2827975
Avocado	-0.0375106	0.5550635	-1.1247251	1.0443457
Vegetable	0.2003486	0.2795536	-0.3587789	0.7429298
Breakfast	-0.5281622	0.6648215	-1.8195506	0.8246326
Other	1.3065765	0.3052995	0.7141348	1.8949340

Parameter	Post. Mean	Post. Sd	95% CI Low	95% CI High
sigma	1.1542459	0.0556615	1.0497315	1.2689966

Model Interpretations