STA610 Case Study 1

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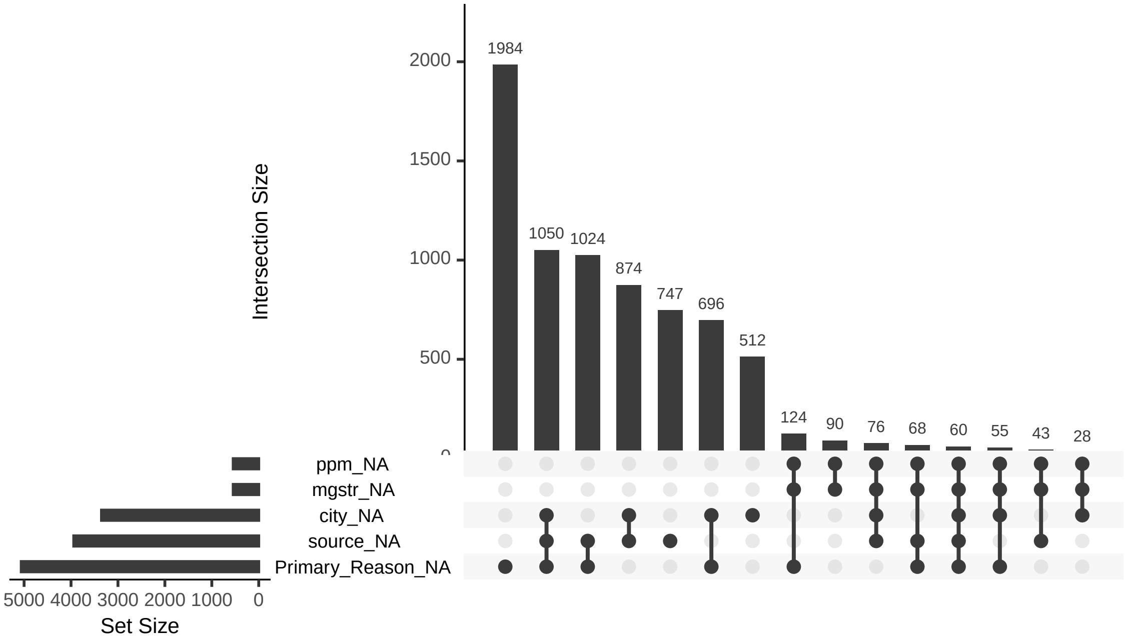
Introduction

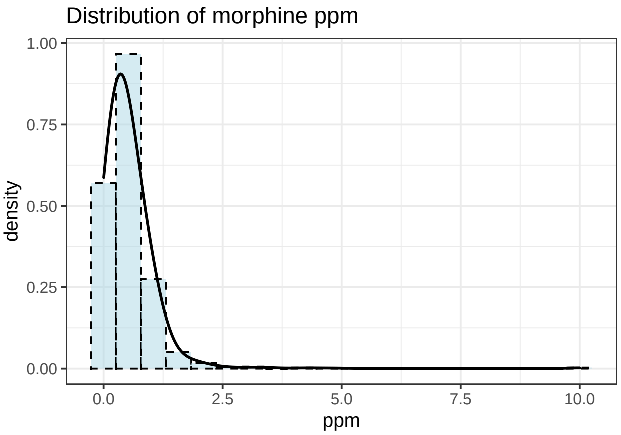
EDA

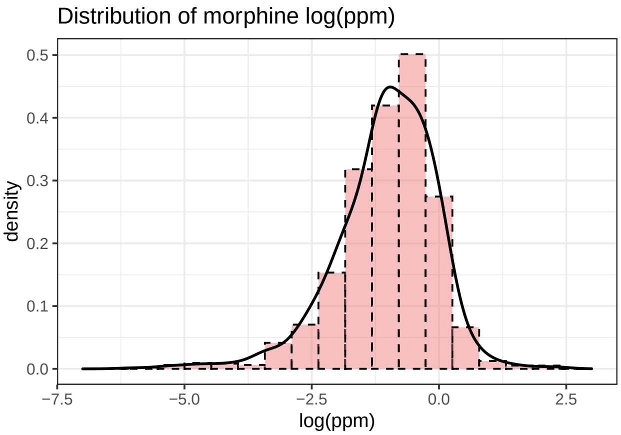
Missing Values



Response Distribution

First, a look at the distributions of the response variable "ppm". Observations with ppm between the 0.1 and 99.9 percentiles were considered so as to avoid the influence of extreme outliers on the analysis of the ppm distribution.





The distribution of ppm is clearly right-skewed, and it is strictly nonnegative in value, so a log transformation may be appropriate. The distribution of log(ppm) is given above, and appears closer to the desired normal.

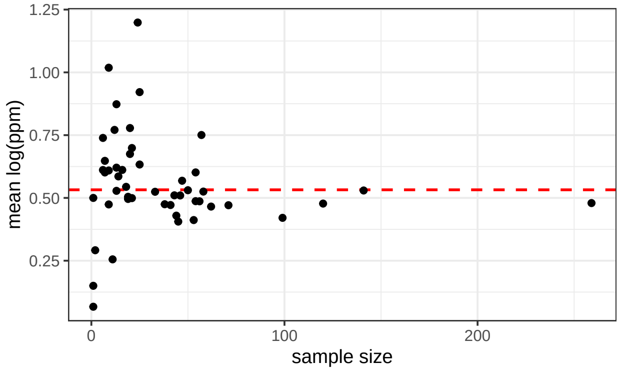
state vs. log(ppm)

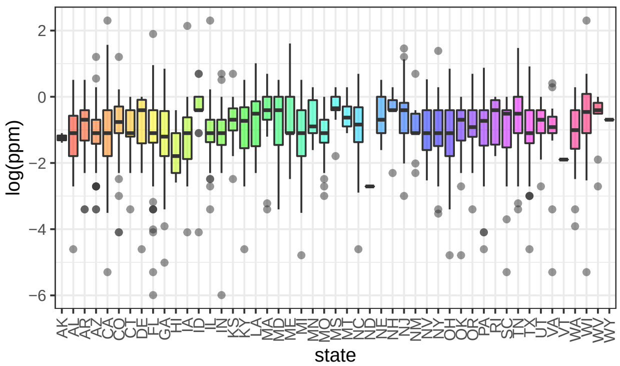
Table 1: 7 states with smallest sample size

North Dakota	Vermont	Washington, DC	Wyoming	Alaska
1	1	1	1	2

Table 2: 7 states with largest sample size

Arizona	Michigan	Texas	Florida	California
71	99	120	141	259



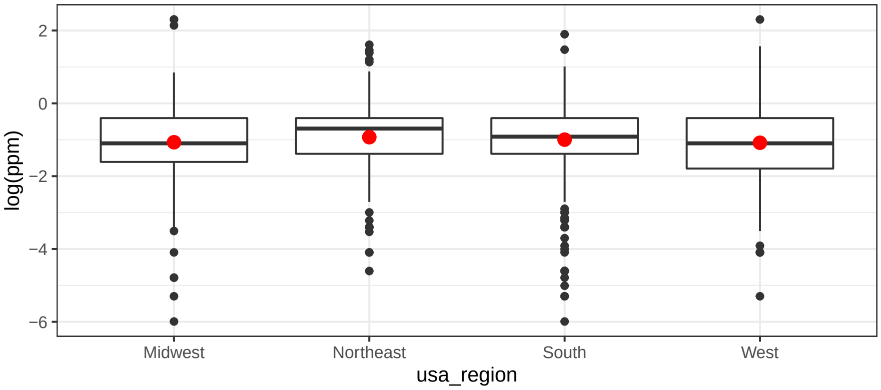


We observe that the within-state means for states with higher sample sizes in general adhere more closely to the grand mean. It is also evident that the log(ppm) distributions differ little as compared to the within-state variance. This is conducive to the borrowing of information between states.

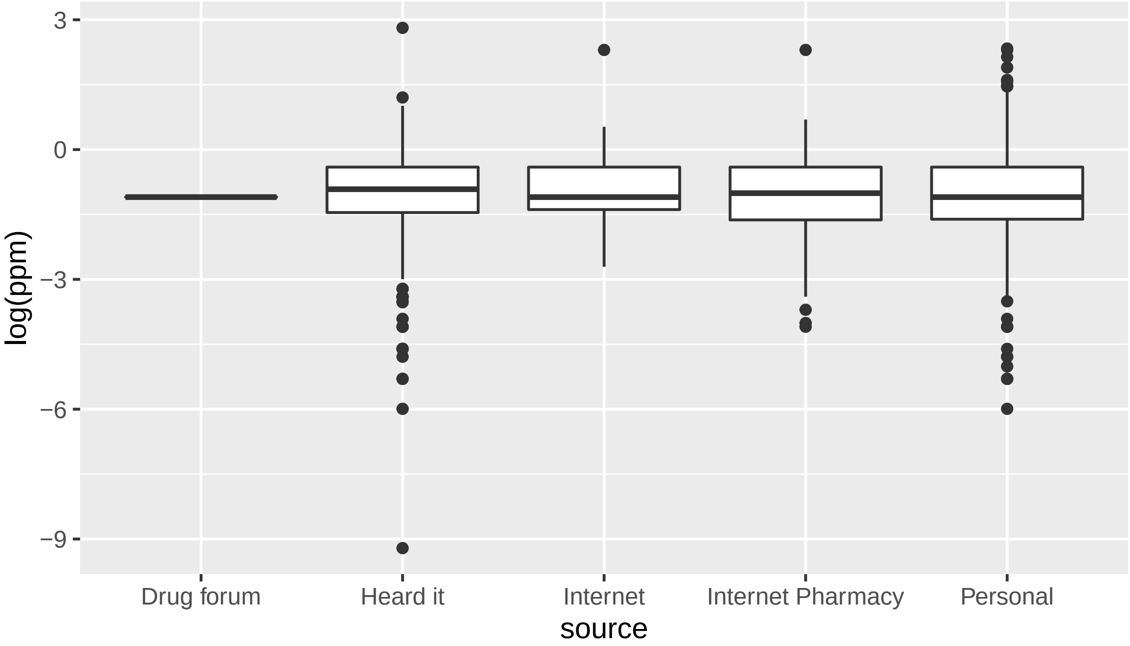
region vs. log(ppm)

We also have access to the broader region in which a purchase is made. This could be useful if we wanted to develop a simpler model that still captured variation by purchase location.

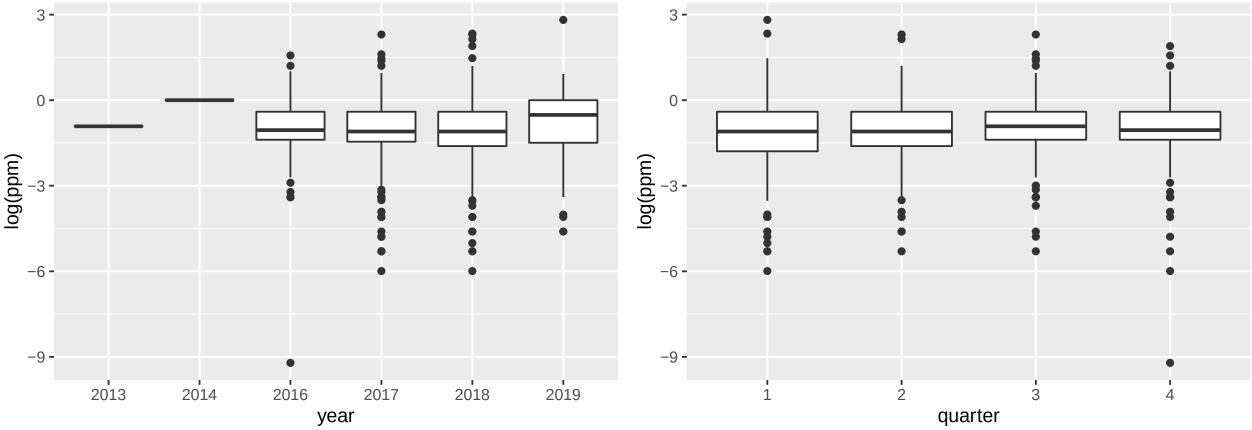
	usa_region	n	mean
1	Midwest	386	−1.069
2	Northeast	191	−0.930
3	South	673	−0.998
4	West	583	−1.083



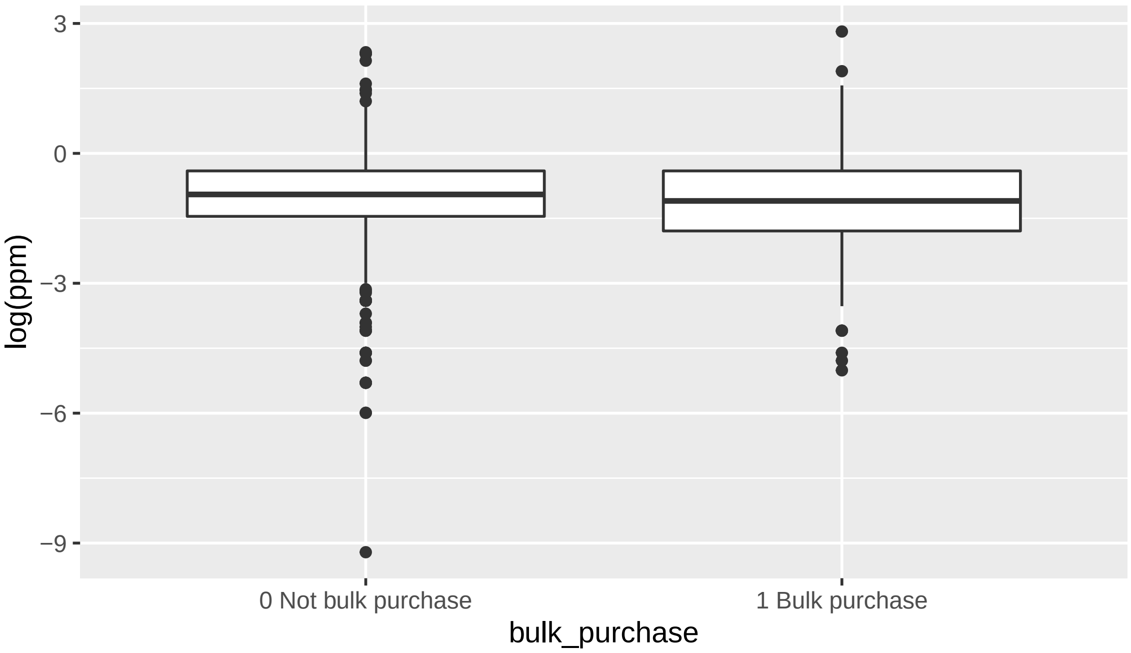
source vs. log(ppm)



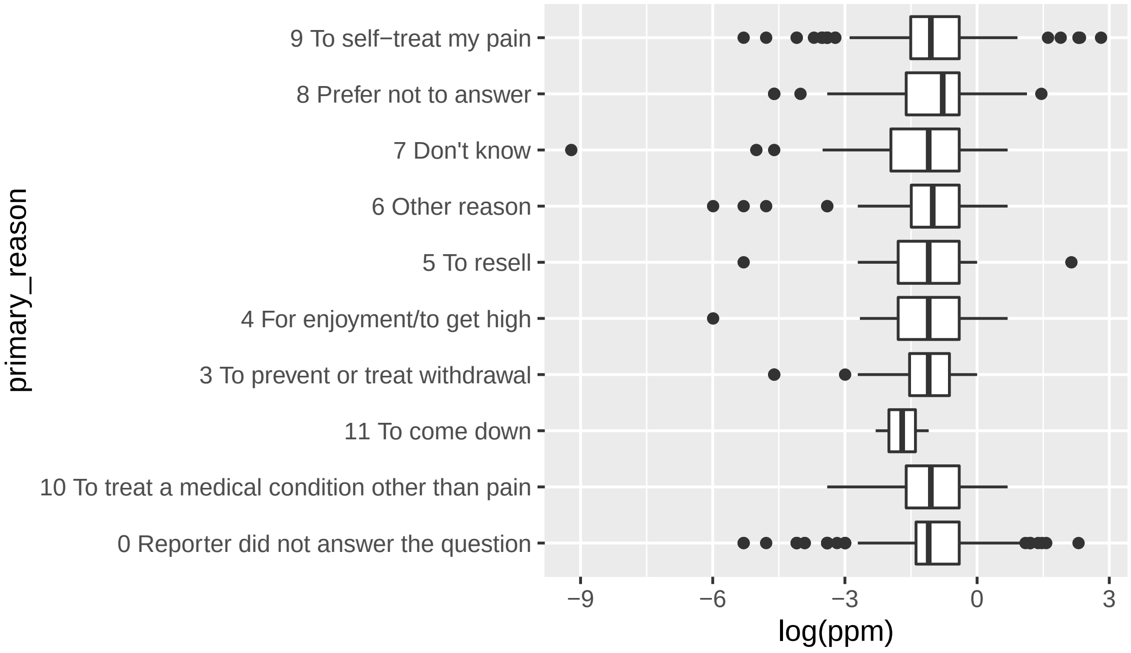
year & quarter vs.log(ppm)



bulk_purchase vs.log(ppm)



Primary_Reason vs.log(ppm)



Model

sth. wrong

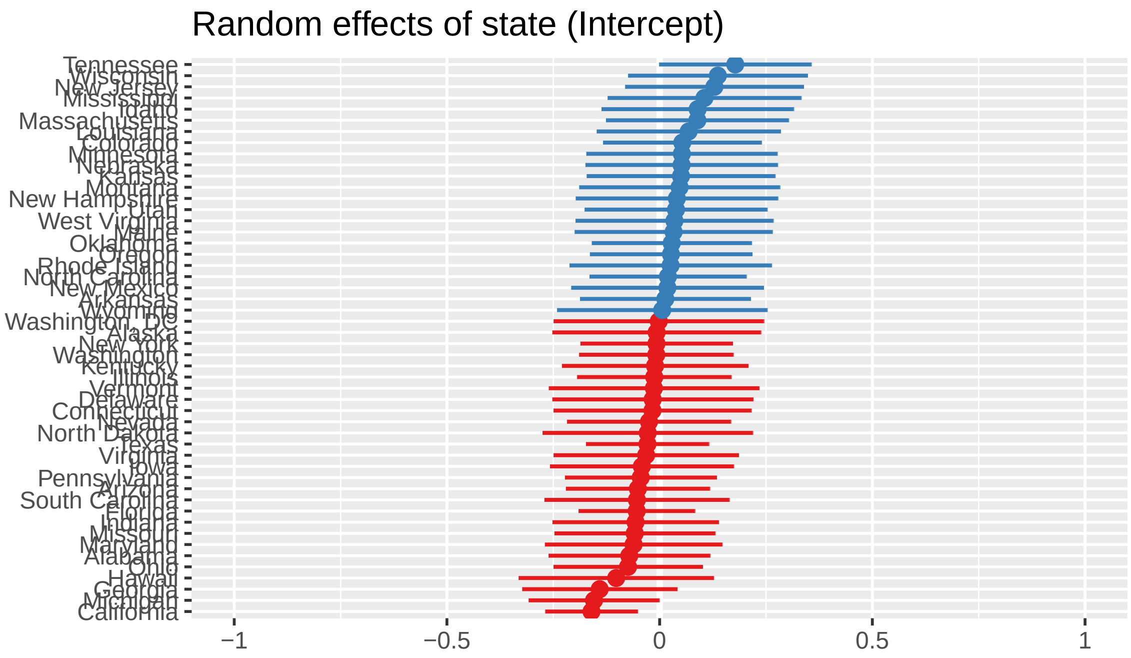
```
## Data: morph_data
## Models:
## model1: log(ppm) ~ (1 | state)
## model2: log(ppm) ~ bulk_purchase + (1 | state)
##        npar    AIC    BIC  logLik deviance  Chisq Df Pr(>Chisq)
## model1    3 5201.8 5218.3 -2597.9   5195.8
## model2    4 5200.8 5222.8 -2596.4   5192.8 3.0152  1    0.08249 .
## ---
## Signif. codes:  0 ’***’ 0.001 ’**’ 0.01 ’*’ 0.05 ’.’ 0.1 ’ ’ 1

## Data: morph_data
## Models:
## model2: log(ppm) ~ bulk_purchase + (1 | state)
## model3: log(ppm) ~ -1 + bulk_purchase + (1 | state)
##        npar    AIC    BIC  logLik deviance Chisq Df Pr(>Chisq)
## model2    4 5200.8 5222.8 -2596.4   5192.8
## model3    4 5200.8 5222.8 -2596.4   5192.8     0  0  < 2.2e-16 ***
## ---
## Signif. codes:  0 ’***’ 0.001 ’**’ 0.01 ’*’ 0.05 ’.’ 0.1 ’ ’ 1

## Data: morph_data
## Models:
## model2: log(ppm) ~ bulk_purchase + (1 | state)
## model4: log(ppm) ~ bulk_purchase + source + (1 | state)
##        npar    AIC    BIC  logLik deviance  Chisq Df Pr(>Chisq)
## model2    4 5200.8 5222.8 -2596.4   5192.8
## model4    8 5207.6 5251.7 -2595.8   5191.6 1.1984  4     0.8784

## Data: morph_data
## Models:
## model2: log(ppm) ~ bulk_purchase + (1 | state)
## model5: log(ppm) ~ bulk_purchase + source + year + (1 | state)
##        npar    AIC    BIC  logLik deviance  Chisq Df Pr(>Chisq)
## model2    4 5200.8 5222.8 -2596.4   5192.8
## model5   13 5213.9 5285.7 -2594.0   5187.9 4.8328  9     0.8486

## Data: morph_data
## Models:
## model2: log(ppm) ~ bulk_purchase + (1 | state)
## model6: log(ppm) ~ bulk_purchase + source + quarter + (1 | state)
##        npar    AIC    BIC  logLik deviance  Chisq Df Pr(>Chisq)
## model2    4 5200.8 5222.8 -2596.4   5192.8
## model6   11 5207.9 5268.5 -2592.9   5185.9 6.9289  7     0.4363

## Data: morph_data
## Models:
## model2: log(ppm) ~ bulk_purchase + (1 | state)
## model7: log(ppm) ~ bulk_purchase + source + (1 | year) + (1 | state)
##        npar    AIC    BIC  logLik deviance  Chisq Df Pr(>Chisq)
## model2    4 5200.8 5222.8 -2596.4   5192.8
## model7    9 5209.6 5259.2 -2595.8   5191.6 1.1984  5      0.945
```

final model

log(ppm) ~ bulk_purchase + (1 | state)

consider using BIC

continue. . .



```
## Linear mixed model fit by REML ['lmerMod']
## Formula: log(ppm) ~ -1 + bulk_purchase + (1 | state)
##    Data: morph_data
##
## REML criterion at convergence: 5201.8
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -8.2634 -0.4819  0.0343  0.6322  3.9277
##
## Random effects:
##  Groups   Name        Variance Std.Dev.
##  state    (Intercept) 0.01613  0.1270
##  Residual             0.97910  0.9895
## Number of obs: 1837, groups:  state, 50
##
## Fixed effects:
##                                  Estimate Std. Error t value
## bulk_purchase0 Not bulk purchase -0.97237    0.03526  -27.57
## bulk_purchase1 Bulk purchase     -1.06556    0.05187  -20.55
##
## Correlation of Fixed Effects:
##             b_0Nbp
## blk_prch1Bp 0.289
```

```
##                                    Estimate Std. Error   t value
## bulk_purchase0 Not bulk purchase -0.9723734 0.03526222 -27.57550
## bulk_purchase1 Bulk purchase     -1.0655603 0.05186505 -20.54486
##                                       2.5 %     97.5 %
## .sig01                           0.05007826  0.2043788
## .sigma                           0.95777569  1.0224962
## bulk_purchase0 Not bulk purchase -1.04215868 -0.8978858
## bulk_purchase1 Bulk purchase     -1.16831675 -0.9619632
```

Influence