Municipal Solid Waste Generation Varies Across Time and Space

Brookhaven 2017

# Dataset

## Original

Attach original data. Exclude columns with grams since the values are too small.

## Data for further analyses

Prepare data for the analyses. Add new columns: District, Region, Quarter

data2017 <- data2017\_ori %>%  
 add\_column(District = as\_factor(rep(1:35, each=52)))  
  
data\_region$District <- as\_factor(data\_region$District) #change district in data region to factors  
data2017 <- data2017 %>%  
 left\_join(data\_region, by = "District") %>%  
 add\_column(Quarter = as\_factor(rep(rep(1:4, each=13), 35)))  
  
data2017

## # A tibble: 1,820 × 17  
## `Location ID` Date M Th Ratio Week Edited\_MSW\_Tons All\_MSW\_Tons  
## <chr> <chr> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl>  
## 1 DIS01 01/02/20… 23.9 27.5 0.651 1 51.4 51.4  
## 2 DIS01 01/09/20… 21.5 22.5 0.716 2 44.0 44.0  
## 3 DIS01 01/19/20… NA 40.4 NA 3 NA 40.4  
## 4 DIS01 01/23/20… 28.8 17.8 1.21 4 46.6 46.6  
## 5 DIS01 01/30/20… 26.2 16.2 1.22 5 42.4 42.4  
## 6 DIS01 02/06/20… 25.6 6.02 NA 6 NA 31.6  
## 7 DIS01 02/13/20… 22.5 18.7 0.900 7 41.2 41.2  
## 8 DIS01 02/23/20… NA 41.6 NA 8 NA 41.6  
## 9 DIS01 02/27/20… 31.2 17.4 1.34 9 48.6 48.6  
## 10 DIS01 03/06/20… 25.4 18.2 1.04 10 43.6 43.6  
## # ℹ 1,810 more rows  
## # ℹ 9 more variables: Tot\_Recycling\_Tons <dbl>, Waste\_Gen\_Tons <dbl>,  
## # Edited\_MSW\_lbsHHd <dbl>, All\_MSW\_lbsHHd <dbl>, Tot\_Recycling\_lbsHHd <dbl>,  
## # Waste\_Gen\_lbsHHd <dbl>, District <fct>, Region <chr>, Quarter <fct>

#nrow(data\_region %>%  
 # filter(Region == "south"))

# MSW

## MSW Weekly Ratio

### T-Test on weekly ratio for all districts combined.

Perform t-test with all data. Exclude blank rows (NA),

t.test(data2017$Ratio, na.action="na.omit", mu = 1)

##   
## One Sample t-test  
##   
## data: data2017$Ratio  
## t = 31.902, df = 1456, p-value < 2.2e-16  
## alternative hypothesis: true mean is not equal to 1  
## 95 percent confidence interval:  
## 1.205525 1.232455  
## sample estimates:  
## mean of x   
## 1.21899

### T-Test on weekly ratio for each district.

Perform t-test for each district’s weekly ratios. Exclude blank rows (NA),

Ratio\_ttest\_district <- tibble(District = unique(data2017$District), Mean = NA, T.Stat = NA, P.Val = NA)  
  
for (i in 1:nrow(Ratio\_ttest\_district)) {  
 Ratio\_ttest\_district$Mean[i] <- round(t.test(data2017$Ratio[data2017$District == Ratio\_ttest\_district$District[i]], na.action="na.omit", mu=1)$estimate, 3)  
 Ratio\_ttest\_district$T.Stat[i] <- round(t.test(data2017$Ratio[data2017$District == Ratio\_ttest\_district$District[i]], na.action="na.omit", mu=1)$statistic, 3)  
 Ratio\_ttest\_district$P.Val[i] <- round(t.test(data2017$Ratio[data2017$District == Ratio\_ttest\_district$District[i]], na.action="na.omit", mu=1)$p.value, 3)  
}  
  
print.data.frame(Ratio\_ttest\_district, row.names = F)

## District Mean T.Stat P.Val  
## 1 1.161 5.129 0.000  
## 2 1.033 0.862 0.394  
## 3 1.093 3.624 0.001  
## 4 1.209 8.316 0.000  
## 5 1.190 7.730 0.000  
## 6 1.243 6.521 0.000  
## 7 1.210 6.672 0.000  
## 8 1.156 5.983 0.000  
## 9 1.158 2.612 0.013  
## 10 1.172 5.620 0.000  
## 11 1.311 13.500 0.000  
## 12 1.346 6.418 0.000  
## 13 1.111 6.469 0.000  
## 14 1.203 9.673 0.000  
## 15 1.257 7.265 0.000  
## 16 1.100 3.848 0.000  
## 17 1.241 7.037 0.000  
## 18 1.362 13.536 0.000  
## 19 1.299 5.333 0.000  
## 20 1.264 8.147 0.000  
## 21 1.154 6.815 0.000  
## 22 1.361 5.757 0.000  
## 23 1.285 9.517 0.000  
## 24 1.599 6.996 0.000  
## 25 1.094 3.505 0.001  
## 26 1.260 10.961 0.000  
## 27 1.215 7.291 0.000  
## 28 1.177 9.387 0.000  
## 29 1.280 4.422 0.000  
## 30 1.244 8.276 0.000  
## 31 1.319 15.365 0.000  
## 32 1.220 5.674 0.000  
## 33 1.075 2.753 0.009  
## 34 1.141 4.976 0.000  
## 35 1.105 6.193 0.000

### T-Test on weekly ratio for each week with all districts combined.

Exclude NA values. Exclude week 6 where Ratios = NA.

data2017\_week <- data2017 %>%  
 filter(Ratio != is.na(Ratio)) %>%  
 arrange(Week)  
  
Ratio\_ttest\_week <- tibble(Week = unique(data2017\_week$Week), Mean = NA, T.Stat = NA, P.Val = NA)  
  
for (i in 1:nrow(Ratio\_ttest\_week)) {  
 Ratio\_ttest\_week$Mean[i] <- round(t.test(data2017\_week$Ratio[data2017\_week$Week == Ratio\_ttest\_week$Week[i]], na.action="na.omit", mu=1)$estimate, 3)  
 Ratio\_ttest\_week$T.Stat[i] <- round(t.test(data2017\_week$Ratio[data2017\_week$Week == Ratio\_ttest\_week$Week[i]], na.action="na.omit", mu=1)$statistic, 3)  
 Ratio\_ttest\_week$P.Val[i] <- round(t.test(data2017\_week$Ratio[data2017\_week$Week == Ratio\_ttest\_week$Week[i]], na.action="na.omit", mu=1)$p.value, 3)  
}  
  
print.data.frame(Ratio\_ttest\_week, row.names = F)

## Week Mean T.Stat P.Val  
## 1 0.989 -0.236 0.815  
## 2 0.789 -6.236 0.000  
## 3 1.110 5.925 0.001  
## 4 0.985 -0.438 0.664  
## 5 1.337 13.126 0.000  
## 7 1.366 8.746 0.000  
## 8 1.138 1.448 0.191  
## 9 1.394 11.250 0.000  
## 10 1.232 4.636 0.000  
## 11 1.464 6.008 0.009  
## 12 1.357 13.835 0.000  
## 13 1.111 6.438 0.000  
## 14 1.378 10.624 0.000  
## 15 1.203 6.063 0.000  
## 16 1.324 9.573 0.000  
## 17 1.334 4.422 0.000  
## 18 1.304 6.937 0.000  
## 19 1.265 5.176 0.000  
## 20 1.132 5.680 0.000  
## 21 1.234 9.160 0.000  
## 22 1.039 0.988 0.356  
## 23 1.210 5.487 0.000  
## 24 1.177 6.407 0.000  
## 25 1.093 3.121 0.004  
## 26 1.202 3.806 0.001  
## 27 0.875 -1.479 0.177  
## 28 1.223 4.453 0.000  
## 29 1.236 9.783 0.000  
## 30 1.126 5.460 0.000  
## 31 1.230 7.505 0.000  
## 32 1.155 4.661 0.000  
## 33 1.204 6.570 0.000  
## 34 1.209 4.943 0.000  
## 35 1.136 6.065 0.000  
## 36 1.103 2.576 0.037  
## 37 1.319 5.788 0.000  
## 38 1.237 7.487 0.000  
## 39 1.288 12.538 0.000  
## 40 1.221 6.203 0.000  
## 41 1.051 1.663 0.140  
## 42 1.168 3.586 0.001  
## 43 1.259 5.722 0.000  
## 44 1.046 1.493 0.145  
## 45 1.210 5.563 0.000  
## 46 1.374 5.760 0.000  
## 47 1.814 3.404 0.011  
## 48 1.618 7.181 0.000  
## 49 1.352 6.999 0.000  
## 50 1.277 3.337 0.016  
## 51 1.081 3.983 0.000  
## 52 0.892 -2.925 0.022

## MSW Quarterly

Divide data into 4 quarters: 1 (week1-13), 2 (week14-26), 3 (week27-39), 4 (week40-52) Compare all possible quarter comparison on Waste Generation rates. ### All Districts combined

round(TukeyHSD(aov(Edited\_MSW\_lbsHHd ~ Quarter, data=data2017))$Quarter,4)

## diff lwr upr p adj  
## 2-1 1.6052 1.3781 1.8323 0e+00  
## 3-1 1.1306 0.9005 1.3608 0e+00  
## 4-1 0.7381 0.4953 0.9809 0e+00  
## 3-2 -0.4746 -0.6857 -0.2635 0e+00  
## 4-2 -0.8671 -1.0919 -0.6423 0e+00  
## 4-3 -0.3925 -0.6204 -0.1646 1e-04

### Each district

Compare all possible quarter comparison on Waste Generation rates for each district.

for(i in 1:35) {  
 cat(paste0("\n District ", i))  
 cat("\n")  
 print(  
 round(  
 TukeyHSD(aov(data2017$Edited\_MSW\_lbsHHd[data2017$District == i] ~ data2017$Quarter[data2017$District == i]))$`data2017$Quarter[data2017$District == i]`,  
 4)  
 )  
}

##   
## District 1  
## diff lwr upr p adj  
## 2-1 1.7178 1.1594 2.2762 0.0000  
## 3-1 1.4501 0.8916 2.0085 0.0000  
## 4-1 0.8046 0.1860 1.4232 0.0065  
## 3-2 -0.2678 -0.8002 0.2647 0.5371  
## 4-2 -0.9132 -1.5085 -0.3180 0.0011  
## 4-3 -0.6455 -1.2407 -0.0502 0.0292  
##   
## District 2  
## diff lwr upr p adj  
## 2-1 1.2699 0.5000 2.0398 0.0004  
## 3-1 0.6857 -0.0843 1.4556 0.0956  
## 4-1 0.7018 -0.1466 1.5502 0.1353  
## 3-2 -0.5842 -1.2971 0.1286 0.1408  
## 4-2 -0.5681 -1.3651 0.2288 0.2384  
## 4-3 0.0161 -0.7808 0.8131 0.9999  
##   
## District 3  
## diff lwr upr p adj  
## 2-1 1.5154 0.6956 2.3352 0.0001  
## 3-1 0.9396 0.1039 1.7752 0.0224  
## 4-1 1.3373 0.4339 2.2407 0.0017  
## 3-2 -0.5758 -1.3519 0.2002 0.2075  
## 4-2 -0.1781 -1.0267 0.6705 0.9417  
## 4-3 0.3977 -0.4662 1.2616 0.6062  
##   
## District 4  
## diff lwr upr p adj  
## 2-1 1.3116 0.7812 1.8419 0.0000  
## 3-1 1.0860 0.5461 1.6260 0.0000  
## 4-1 0.7437 0.1627 1.3247 0.0077  
## 3-2 -0.2256 -0.7106 0.2595 0.5975  
## 4-2 -0.5679 -1.0982 -0.0375 0.0320  
## 4-3 -0.3423 -0.8822 0.1976 0.3340  
##   
## District 5  
## diff lwr upr p adj  
## 2-1 1.2931 0.5998 1.9864 0.0001  
## 3-1 0.9154 0.2095 1.6212 0.0068  
## 4-1 0.7142 -0.0453 1.4737 0.0716  
## 3-2 -0.3777 -1.0118 0.2563 0.3882  
## 4-2 -0.5789 -1.2722 0.1144 0.1294  
## 4-3 -0.2012 -0.9070 0.5047 0.8680  
##   
## District 6  
## diff lwr upr p adj  
## 2-1 1.2021 0.2066 2.1976 0.0126  
## 3-1 0.9692 -0.0262 1.9647 0.0588  
## 4-1 -0.1616 -1.2258 0.9026 0.9767  
## 3-2 -0.2329 -1.1545 0.6888 0.9045  
## 4-2 -1.3637 -2.3592 -0.3682 0.0039  
## 4-3 -1.1308 -2.1263 -0.1354 0.0207  
##   
## District 7  
## diff lwr upr p adj  
## 2-1 1.5979 0.7698 2.4260 0.0000  
## 3-1 1.0289 0.2008 1.8570 0.0098  
## 4-1 0.2055 -0.6831 1.0942 0.9249  
## 3-2 -0.5690 -1.3586 0.2206 0.2309  
## 4-2 -1.3924 -2.2452 -0.5396 0.0005  
## 4-3 -0.8234 -1.6762 0.0295 0.0618  
##   
## District 8  
## diff lwr upr p adj  
## 2-1 1.1911 0.2336 2.1486 0.0097  
## 3-1 1.0304 0.0729 1.9879 0.0308  
## 4-1 1.1157 0.0550 2.1764 0.0360  
## 3-2 -0.1607 -1.0737 0.7522 0.9646  
## 4-2 -0.0754 -1.0961 0.9453 0.9972  
## 4-3 0.0853 -0.9354 1.1060 0.9959  
##   
## District 9  
## diff lwr upr p adj  
## 2-1 0.8199 -0.3390 1.9788 0.2438  
## 3-1 1.1088 -0.0710 2.2886 0.0719  
## 4-1 0.1282 -1.1056 1.3620 0.9922  
## 3-2 0.2889 -0.7710 1.3488 0.8827  
## 4-2 -0.6917 -1.8114 0.4279 0.3571  
## 4-3 -0.9806 -2.1219 0.1606 0.1136  
##   
## District 10  
## diff lwr upr p adj  
## 2-1 2.0026 1.0755 2.9297 0.0000  
## 3-1 0.8107 -0.1320 1.7535 0.1142  
## 4-1 0.4472 -0.4956 1.3900 0.5874  
## 3-2 -1.1919 -2.0478 -0.3360 0.0031  
## 4-2 -1.5554 -2.4113 -0.6995 0.0001  
## 4-3 -0.3635 -1.2364 0.5093 0.6830  
##   
## District 11  
## diff lwr upr p adj  
## 2-1 1.4886 0.8914 2.0858 0.0000  
## 3-1 0.8794 0.2714 1.4874 0.0022  
## 4-1 0.4456 -0.2086 1.0998 0.2737  
## 3-2 -0.6092 -1.1553 -0.0630 0.0239  
## 4-2 -1.0430 -1.6402 -0.4458 0.0002  
## 4-3 -0.4338 -1.0418 0.1742 0.2366  
##   
## District 12  
## diff lwr upr p adj  
## 2-1 1.6946 0.5934 2.7958 0.0011  
## 3-1 1.3811 0.2799 2.4824 0.0091  
## 4-1 0.4581 -0.7553 1.6716 0.7415  
## 3-2 -0.3134 -1.3330 0.7061 0.8413  
## 4-2 -1.2364 -2.3763 -0.0966 0.0291  
## 4-3 -0.9230 -2.0629 0.2169 0.1483  
##   
## District 13  
## diff lwr upr p adj  
## 2-1 1.5043 0.9272 2.0813 0.0000  
## 3-1 1.0149 0.4275 1.6024 0.0003  
## 4-1 0.5251 -0.1070 1.1573 0.1322  
## 3-2 -0.4893 -1.0170 0.0384 0.0773  
## 4-2 -0.9791 -1.5561 -0.4021 0.0003  
## 4-3 -0.4898 -1.0772 0.0976 0.1301  
##   
## District 14  
## diff lwr upr p adj  
## 2-1 1.7181 1.1732 2.2630 0.0000  
## 3-1 1.0399 0.4852 1.5946 0.0001  
## 4-1 0.6526 0.0557 1.2495 0.0276  
## 3-2 -0.6782 -1.1765 -0.1799 0.0043  
## 4-2 -1.0655 -1.6104 -0.5206 0.0000  
## 4-3 -0.3873 -0.9420 0.1674 0.2537  
##   
## District 15  
## diff lwr upr p adj  
## 2-1 2.2496 1.2330 3.2662 0.0000  
## 3-1 1.6493 0.6327 2.6659 0.0006  
## 4-1 0.5738 -0.5398 1.6874 0.5150  
## 3-2 -0.6003 -1.5095 0.3090 0.3003  
## 4-2 -1.6758 -2.6924 -0.6592 0.0005  
## 4-3 -1.0755 -2.0921 -0.0589 0.0347  
##   
## District 16  
## diff lwr upr p adj  
## 2-1 1.6900 0.8231 2.5569 0.0000  
## 3-1 1.3256 0.4431 2.2081 0.0014  
## 4-1 0.6724 -0.2505 1.5952 0.2211  
## 3-2 -0.3644 -1.1572 0.4283 0.6073  
## 4-2 -1.0176 -1.8551 -0.1802 0.0121  
## 4-3 -0.6532 -1.5068 0.2004 0.1854  
##   
## District 17  
## diff lwr upr p adj  
## 2-1 1.2514 0.5269 1.9759 0.0003  
## 3-1 0.8824 0.1449 1.6200 0.0138  
## 4-1 0.7705 -0.0232 1.5641 0.0597  
## 3-2 -0.3689 -1.0315 0.2937 0.4474  
## 4-2 -0.4809 -1.2054 0.2436 0.2951  
## 4-3 -0.1120 -0.8495 0.6256 0.9765  
##   
## District 18  
## diff lwr upr p adj  
## 2-1 1.4637 0.7797 2.1477 0.0000  
## 3-1 1.3194 0.6231 2.0158 0.0001  
## 4-1 0.6732 -0.0550 1.4014 0.0786  
## 3-2 -0.1443 -0.7698 0.4813 0.9246  
## 4-2 -0.7905 -1.4513 -0.1297 0.0138  
## 4-3 -0.6462 -1.3198 0.0273 0.0640  
##   
## District 19  
## diff lwr upr p adj  
## 2-1 2.1666 0.8664 3.4667 0.0003  
## 3-1 1.2680 -0.0554 2.5915 0.0647  
## 4-1 2.2202 0.8967 3.5437 0.0003  
## 3-2 -0.8985 -2.1359 0.3389 0.2267  
## 4-2 0.0536 -1.1837 1.2910 0.9994  
## 4-3 0.9522 -0.3097 2.2141 0.1979  
##   
## District 20  
## diff lwr upr p adj  
## 2-1 1.4489 0.5076 2.3901 0.0009  
## 3-1 0.7670 -0.1920 1.7261 0.1579  
## 4-1 0.0207 -0.9384 0.9797 0.9999  
## 3-2 -0.6818 -1.6016 0.2379 0.2113  
## 4-2 -1.4282 -2.3480 -0.5085 0.0008  
## 4-3 -0.7464 -1.6844 0.1916 0.1613  
##   
## District 21  
## diff lwr upr p adj  
## 2-1 1.5085 0.8430 2.1740 0.0000  
## 3-1 0.8373 0.1599 1.5148 0.0101  
## 4-1 0.4030 -0.2745 1.0805 0.3951  
## 3-2 -0.6712 -1.3046 -0.0378 0.0341  
## 4-2 -1.1055 -1.7389 -0.4721 0.0002  
## 4-3 -0.4343 -1.0803 0.2116 0.2888  
##   
## District 22  
## diff lwr upr p adj  
## 2-1 2.2477 0.5557 3.9398 0.0054  
## 3-1 2.1894 0.4974 3.8814 0.0069  
## 4-1 0.9366 -0.9169 2.7902 0.5314  
## 3-2 -0.0583 -1.5717 1.4551 0.9996  
## 4-2 -1.3111 -3.0031 0.3809 0.1767  
## 4-3 -1.2528 -2.9448 0.4393 0.2091  
##   
## District 23  
## diff lwr upr p adj  
## 2-1 1.1359 0.3071 1.9648 0.0037  
## 3-1 0.6735 -0.1703 1.5172 0.1590  
## 4-1 0.1994 -0.6443 1.0431 0.9213  
## 3-2 -0.4625 -1.2513 0.3263 0.4079  
## 4-2 -0.9366 -1.7254 -0.1478 0.0143  
## 4-3 -0.4741 -1.2785 0.3303 0.4033  
##   
## District 24  
## diff lwr upr p adj  
## 2-1 2.1386 0.8734 3.4038 0.0003  
## 3-1 1.6231 0.3579 2.8883 0.0075  
## 4-1 1.7662 0.3802 3.1522 0.0079  
## 3-2 -0.5156 -1.6472 0.6160 0.6141  
## 4-2 -0.3724 -1.6376 0.8928 0.8572  
## 4-3 0.1431 -1.1221 1.4083 0.9900  
##   
## District 25  
## diff lwr upr p adj  
## 2-1 0.9906 0.2889 1.6924 0.0029  
## 3-1 0.8350 0.1207 1.5494 0.0167  
## 4-1 0.4827 -0.2860 1.2514 0.3423  
## 3-2 -0.1556 -0.7973 0.4862 0.9135  
## 4-2 -0.5079 -1.2097 0.1938 0.2256  
## 4-3 -0.3523 -1.0667 0.3620 0.5505  
##   
## District 26  
## diff lwr upr p adj  
## 2-1 1.3731 0.9284 1.8178 0.0000  
## 3-1 0.9028 0.4501 1.3555 0.0000  
## 4-1 0.7899 0.3028 1.2770 0.0006  
## 3-2 -0.4703 -0.8770 -0.0637 0.0181  
## 4-2 -0.5832 -1.0279 -0.1385 0.0061  
## 4-3 -0.1129 -0.5656 0.3398 0.9068  
##   
## District 27  
## diff lwr upr p adj  
## 2-1 1.2542 0.7211 1.7874 0.0000  
## 3-1 0.7923 0.2488 1.3357 0.0020  
## 4-1 0.7155 0.1280 1.3030 0.0118  
## 3-2 -0.4619 -0.9666 0.0428 0.0829  
## 4-2 -0.5388 -1.0906 0.0131 0.0578  
## 4-3 -0.0768 -0.6386 0.4850 0.9827  
##   
## District 28  
## diff lwr upr p adj  
## 2-1 1.7097 1.1214 2.2980 0.0000  
## 3-1 1.2999 0.7010 1.8988 0.0000  
## 4-1 0.8700 0.2255 1.5144 0.0046  
## 3-2 -0.4098 -0.9478 0.1282 0.1883  
## 4-2 -0.8397 -1.4280 -0.2514 0.0026  
## 4-3 -0.4300 -1.0289 0.1689 0.2319  
##   
## District 29  
## diff lwr upr p adj  
## 2-1 2.1181 1.0454 3.1908 0.0000  
## 3-1 1.6189 0.5259 2.7119 0.0015  
## 4-1 0.9119 -0.1608 1.9846 0.1210  
## 3-2 -0.4992 -1.5474 0.5490 0.5861  
## 4-2 -1.2062 -2.2332 -0.1792 0.0155  
## 4-3 -0.7070 -1.7552 0.3412 0.2870  
##   
## District 30  
## diff lwr upr p adj  
## 2-1 1.8823 1.2770 2.4876 0.0000  
## 3-1 1.2326 0.6164 1.8488 0.0000  
## 4-1 0.9292 0.2661 1.5923 0.0032  
## 3-2 -0.6497 -1.2033 -0.0962 0.0161  
## 4-2 -0.9531 -1.5584 -0.3478 0.0008  
## 4-3 -0.3034 -0.9196 0.3128 0.5519  
##   
## District 31  
## diff lwr upr p adj  
## 2-1 2.0975 1.3314 2.8635 0.0000  
## 3-1 1.3370 0.5572 2.1169 0.0003  
## 4-1 0.9972 0.1580 1.8364 0.0146  
## 3-2 -0.7604 -1.4610 -0.0598 0.0291  
## 4-2 -1.1003 -1.8663 -0.3342 0.0024  
## 4-3 -0.3399 -1.1197 0.4400 0.6461  
##   
## District 32  
## diff lwr upr p adj  
## 2-1 1.7153 0.7543 2.6763 0.0001  
## 3-1 0.7062 -0.2721 1.6844 0.2316  
## 4-1 0.5693 -0.3918 1.5303 0.3994  
## 3-2 -1.0091 -1.9238 -0.0945 0.0255  
## 4-2 -1.1460 -2.0422 -0.2499 0.0073  
## 4-3 -0.1369 -1.0515 0.7778 0.9781  
##   
## District 33  
## diff lwr upr p adj  
## 2-1 0.9019 0.0888 1.7150 0.0249  
## 3-1 0.7967 -0.0311 1.6244 0.0628  
## 4-1 0.0814 -0.8093 0.9721 0.9946  
## 3-2 -0.1053 -0.8489 0.6383 0.9808  
## 4-2 -0.8206 -1.6337 -0.0075 0.0472  
## 4-3 -0.7153 -1.5431 0.1124 0.1104  
##   
## District 34  
## diff lwr upr p adj  
## 2-1 1.9686 1.0502 2.8871 0.0000  
## 3-1 1.3943 0.4594 2.3293 0.0014  
## 4-1 0.8597 -0.0753 1.7947 0.0815  
## 3-2 -0.5743 -1.4484 0.2998 0.3084  
## 4-2 -1.1089 -1.9831 -0.2348 0.0079  
## 4-3 -0.5346 -1.4261 0.3568 0.3879  
##   
## District 35  
## diff lwr upr p adj  
## 2-1 1.4149 0.7794 2.0505 0.0000  
## 3-1 1.1513 0.5043 1.7983 0.0002  
## 4-1 0.7222 0.0260 1.4184 0.0396  
## 3-2 -0.2636 -0.8449 0.3176 0.6166  
## 4-2 -0.6927 -1.3283 -0.0572 0.0283  
## 4-3 -0.4291 -1.0761 0.2179 0.2957

## MSW Geographic Comparisons

### District Comparisons

Compare edited MSW rates (lbs/HH/d) for all possible combinations of 35 districts.

ano1 <- aov(Edited\_MSW\_lbsHHd ~ District, data=data2017)  
  
tukey1 <- TukeyHSD(ano1)  
tukey1\_districts <- as\_tibble(tukey1$District)  
tukey1\_districts$District\_Pair <- rownames(tukey1$District)  
tukey1\_districts$`p adj` <- round(tukey1\_districts$`p adj`, 3)  
  
length(tukey1\_districts$`p adj`)

## [1] 595

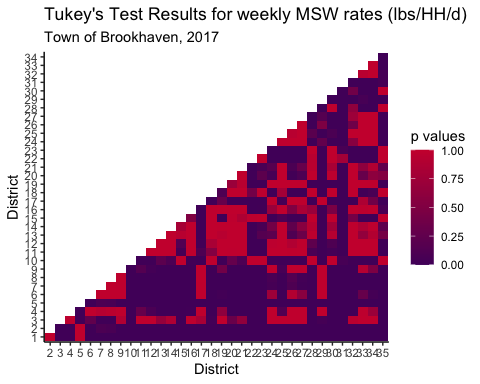
nrow(tukey1\_districts %>%  
 filter(`p adj` > .05))

## [1] 265

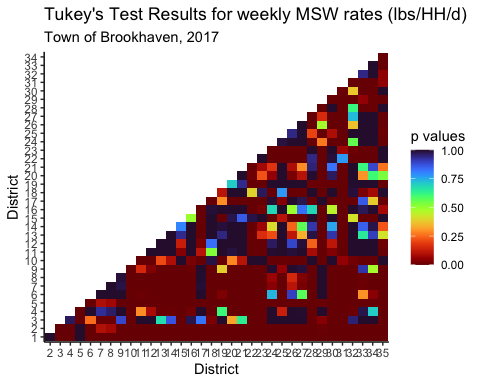
nrow(tukey1\_districts %>%  
 filter(`p adj` <= .05))

## [1] 330

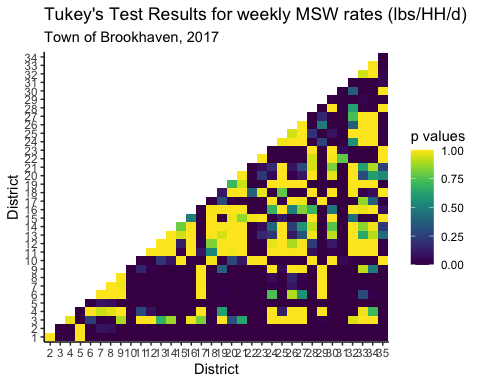
tukey1\_districts$District\_X <- as\_factor(sub("\\-.\*", "", tukey1\_districts$District\_Pair))  
tukey1\_districts$District\_Y <- as\_factor(sub(".\*\\-", "", tukey1\_districts$District\_Pair))  
  
tukey1\_districts %>%  
 ggplot(aes(District\_X, District\_Y, fill= `p adj`)) +   
 geom\_tile() +  
 labs(x="District", y="District", fill="p values") +  
 ggtitle("Tukey's Test Results for weekly MSW rates (lbs/HH/d)", subtitle = "Town of Brookhaven, 2017") +  
 theme\_classic() +  
 scale\_fill\_gradient(low = "#52006A", high = "#CD113B")



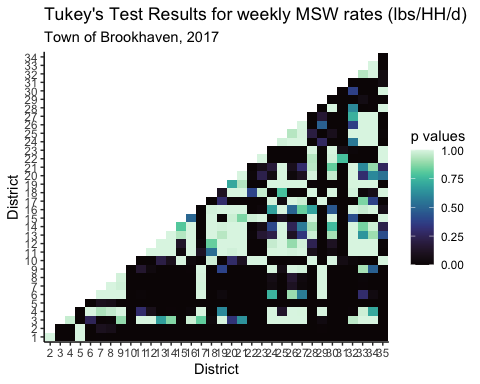
#viridis color 1  
tukey1\_districts %>%  
 ggplot(aes(District\_X, District\_Y, fill= `p adj`)) +   
 geom\_tile(color="transparent") +  
 labs(x="District", y="District", fill="p values") +  
 ggtitle("Tukey's Test Results for weekly MSW rates (lbs/HH/d)", subtitle = "Town of Brookhaven, 2017") +  
 theme\_classic() +  
 scale\_fill\_viridis(option="turbo", direction =-1)



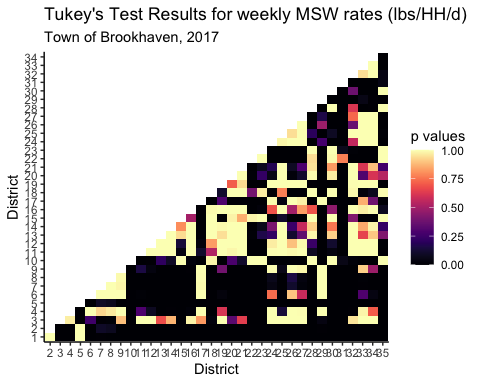
#viridis color 2  
tukey1\_districts %>%  
 ggplot(aes(District\_X, District\_Y, fill= `p adj`)) +   
 geom\_tile(color="transparent") +  
 labs(x="District", y="District", fill="p values") +  
 ggtitle("Tukey's Test Results for weekly MSW rates (lbs/HH/d)", subtitle = "Town of Brookhaven, 2017") +  
 theme\_classic() +  
 scale\_fill\_viridis(option="viridis")



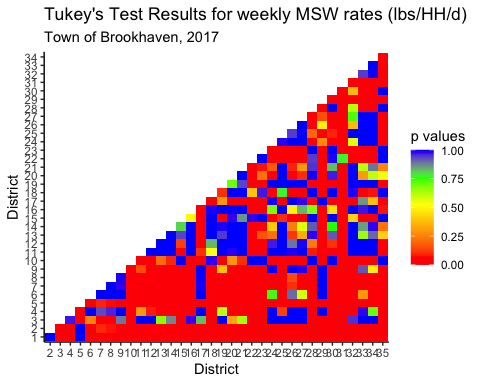
#viridis color 3  
tukey1\_districts %>%  
 ggplot(aes(District\_X, District\_Y, fill= `p adj`)) +   
 geom\_tile() +  
 labs(x="District", y="District", fill="p values") +  
 ggtitle("Tukey's Test Results for weekly MSW rates (lbs/HH/d)", subtitle = "Town of Brookhaven, 2017") +  
 theme\_classic() +  
 scale\_fill\_viridis(option="mako")



#viridis color 4  
tukey1\_districts %>%  
 ggplot(aes(District\_X, District\_Y, fill= `p adj`)) +   
 geom\_tile() +  
 labs(x="District", y="District", fill="p values") +  
 ggtitle("Tukey's Test Results for weekly MSW rates (lbs/HH/d)", subtitle = "Town of Brookhaven, 2017") +  
 theme\_classic() +  
 scale\_fill\_viridis(option="magma")



color\_values <- c(0, .05, .2875, .525, .7625, 1)  
color\_palette <- c("red", "red", "orange", "yellow", "green", "blue")  
  
tukey1\_districts %>%  
 ggplot(aes(District\_X, District\_Y, fill= `p adj`)) +   
 geom\_tile() +  
 labs(x="District", y="District", fill="p values") +  
 ggtitle("Tukey's Test Results for weekly MSW rates (lbs/HH/d)", subtitle = "Town of Brookhaven, 2017") +  
 theme\_classic() +  
 scale\_fill\_gradientn(colors = color\_palette, values = color\_values)

 fi

### Region Comparisons

Compare edited MSW rates (lbs/HH/d) for all possible combinations of 3 regions.

ano2 <- aov(Edited\_MSW\_lbsHHd ~ Region, data=data2017)  
summary(ano2) #Anova

## Df Sum Sq Mean Sq F value Pr(>F)   
## Region 2 639.3 319.6 247.3 <2e-16 \*\*\*  
## Residuals 1454 1879.1 1.3   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
## 363 observations deleted due to missingness

dunn.test(data2017$Edited\_MSW\_lbsHHd, g=data2017$Region, method="bonferroni") #dunn test bonferroni

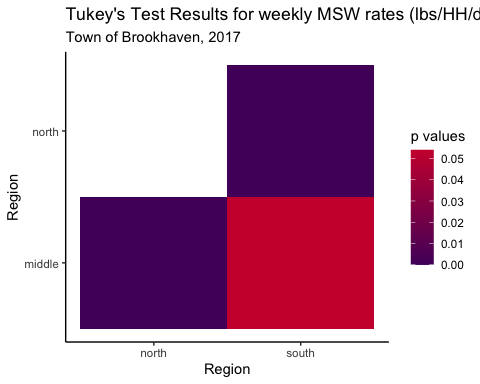
## Kruskal-Wallis rank sum test  
##   
## data: x and group  
## Kruskal-Wallis chi-squared = 382.8022, df = 2, p-value = 0  
##   
##   
## Comparison of x by group   
## (Bonferroni)   
## Col Mean-|  
## Row Mean | middle north  
## ---------+----------------------  
## north | 18.66259  
## | 0.0000\*  
## |  
## south | 1.932115 -15.77819  
## | 0.0800 0.0000\*  
##   
## alpha = 0.05  
## Reject Ho if p <= alpha/2

tukey2 <- TukeyHSD(ano2)  
tukey2\_regions <- as\_tibble(tukey2$Region)  
tukey2\_regions$Region\_Pair <- rownames(tukey2$Region)  
tukey2\_regions$`p adj` <- round(tukey2\_regions$`p adj`, 3)  
print(tukey2\_regions)

## # A tibble: 3 × 5  
## diff lwr upr `p adj` Region\_Pair   
## <dbl> <dbl> <dbl> <dbl> <chr>   
## 1 -1.58 -1.76 -1.41 0 north-middle  
## 2 -0.161 -0.325 0.00236 0.054 south-middle  
## 3 1.42 1.24 1.61 0 south-north

Visualization for region comparisons (MSW).

tukey2\_regions$Region\_X <- as\_factor(sub("\\-.\*", "", tukey2\_regions$Region\_Pair))  
tukey2\_regions$Region\_Y <- as\_factor(sub(".\*\\-", "", tukey2\_regions$Region\_Pair))  
  
tukey2\_regions %>%  
 ggplot(aes(Region\_X, Region\_Y, fill= `p adj`)) +   
 geom\_tile() +  
 labs(x="Region", y="Region", fill="p values") +  
 ggtitle("Tukey's Test Results for weekly MSW rates (lbs/HH/dd)", subtitle = "Town of Brookhaven, 2017") +  
 theme\_classic() +  
 scale\_fill\_gradient(low = "#52006A", high = "#CD113B")



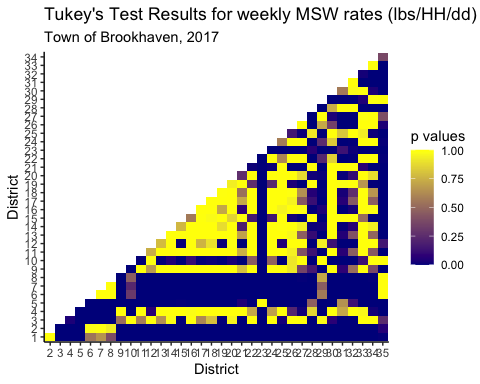
# Recyclables

## Recyclables Geographic Comparison

### Recyclables District Comparison

Compare total recycling rates (lbs/HH/d) for all possible combinations of 35 districts.

ano3 <- aov(Tot\_Recycling\_lbsHHd ~ District, data=data2017)  
  
tukey3 <- TukeyHSD(ano3)  
tukey3\_districts <- as\_tibble(tukey3$District)  
tukey3\_districts$District\_Pair <- rownames(tukey3$District)  
tukey3\_districts$`p adj` <- round(tukey3\_districts$`p adj`, 3)  
  
tukey3\_districts$District\_X <- as\_factor(sub("\\-.\*", "", tukey3\_districts$District\_Pair))  
tukey3\_districts$District\_Y <- as\_factor(sub(".\*\\-", "", tukey3\_districts$District\_Pair))  
  
tukey3\_districts %>%  
 ggplot(aes(District\_X, District\_Y, fill= `p adj`)) +   
 geom\_tile() +  
 labs(x="District", y="District", fill="p values") +  
 ggtitle("Tukey's Test Results for weekly MSW rates (lbs/HH/dd)", subtitle = "Town of Brookhaven, 2017") +  
 theme\_classic() +  
 scale\_fill\_gradient(low = "darkblue", high = "yellow")



length(tukey3\_districts$`p adj`)

## [1] 595

nrow(tukey3\_districts %>%  
 filter(`p adj` > .05))

## [1] 291

nrow(tukey3\_districts %>%  
 filter(`p adj` <= .05))

## [1] 304

### Recyclables Region Comparisons

Compare total recycling rates (lbs/HH/d) for all possible combinations of 3 regions.

ano4 <- aov(Tot\_Recycling\_lbsHHd ~ Region, data=data2017)  
summary(ano4)

## Df Sum Sq Mean Sq F value Pr(>F)   
## Region 2 17.71 8.856 73.91 <2e-16 \*\*\*  
## Residuals 1817 217.71 0.120   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

dunn.test(data2017$Tot\_Recycling\_lbsHHd, g=data2017$Region, method="bonferroni") #dunn test bonferroni

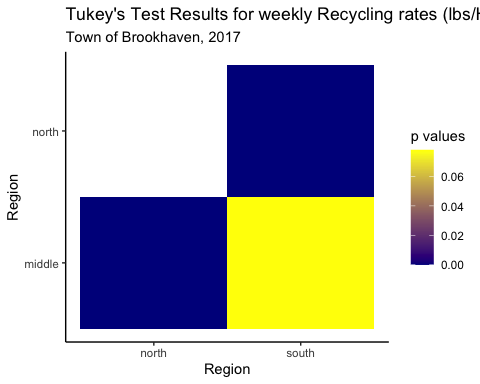
## Kruskal-Wallis rank sum test  
##   
## data: x and group  
## Kruskal-Wallis chi-squared = 136.706, df = 2, p-value = 0  
##   
##   
## Comparison of x by group   
## (Bonferroni)   
## Col Mean-|  
## Row Mean | middle north  
## ---------+----------------------  
## north | -11.29680  
## | 0.0000\*  
## |  
## south | -1.734454 9.065509  
## | 0.1243 0.0000\*  
##   
## alpha = 0.05  
## Reject Ho if p <= alpha/2

tukey4 <- TukeyHSD(ano4)  
tukey4\_regions <- as\_tibble(tukey4$Region)  
tukey4\_regions$Region\_Pair <- rownames(tukey4$Region)  
tukey4\_regions$`p adj` <- round(tukey4\_regions$`p adj`, 3)  
print(tukey4\_regions)

## # A tibble: 3 × 5  
## diff lwr upr `p adj` Region\_Pair   
## <dbl> <dbl> <dbl> <dbl> <chr>   
## 1 0.240 0.192 0.287 0 north-middle  
## 2 0.0412 -0.00352 0.0859 0.078 south-middle  
## 3 -0.198 -0.249 -0.148 0 south-north

Visualization for region comparisons (recyclables).

tukey4\_regions$Region\_X <- as\_factor(sub("\\-.\*", "", tukey4\_regions$Region\_Pair))  
tukey4\_regions$Region\_Y <- as\_factor(sub(".\*\\-", "", tukey4\_regions$Region\_Pair))  
  
tukey4\_regions %>%  
 ggplot(aes(Region\_X, Region\_Y, fill= `p adj`)) +   
 geom\_tile() +  
 labs(x="Region", y="Region", fill="p values") +  
 ggtitle("Tukey's Test Results for weekly Recycling rates (lbs/HH/d)", subtitle = "Town of Brookhaven, 2017") +  
 theme\_classic() +  
 scale\_fill\_gradient(low = "darkblue", high = "yellow")



## Recyclables Quarterly

### All Districts combined

round(TukeyHSD(aov(Tot\_Recycling\_lbsHHd ~ Quarter, data=data2017))$Quarter,4)

## diff lwr upr p adj  
## 2-1 0.1750 0.1148 0.2352 0.0000  
## 3-1 0.1185 0.0582 0.1787 0.0000  
## 4-1 0.1653 0.1051 0.2256 0.0000  
## 3-2 -0.0565 -0.1167 0.0037 0.0750  
## 4-2 -0.0096 -0.0699 0.0506 0.9765  
## 4-3 0.0469 -0.0134 0.1071 0.1878

### Each district

Compare all possible quarter comparison on Waste Generation rates for each district.

for(i in 1:35) {  
 cat(paste0("\n District ", i))  
 cat("\n")  
 print(  
 round(  
 TukeyHSD(aov(data2017$Tot\_Recycling\_lbsHHd[data2017$District == i] ~ data2017$Quarter[data2017$District == i]))$`data2017$Quarter[data2017$District == i]`,  
 4)  
 )  
}

##   
## District 1  
## diff lwr upr p adj  
## 2-1 0.3676 0.1082 0.6270 0.0024  
## 3-1 0.2437 -0.0157 0.5031 0.0727  
## 4-1 0.2068 -0.0526 0.4662 0.1609  
## 3-2 -0.1239 -0.3833 0.1355 0.5855  
## 4-2 -0.1608 -0.4202 0.0987 0.3615  
## 4-3 -0.0369 -0.2963 0.2225 0.9814  
##   
## District 2  
## diff lwr upr p adj  
## 2-1 0.2269 -0.0763 0.5302 0.2054  
## 3-1 0.1409 -0.1623 0.4442 0.6069  
## 4-1 0.3047 0.0015 0.6079 0.0485  
## 3-2 -0.0860 -0.3893 0.2172 0.8742  
## 4-2 0.0778 -0.2255 0.3810 0.9033  
## 4-3 0.1638 -0.1395 0.4670 0.4829  
##   
## District 3  
## diff lwr upr p adj  
## 2-1 0.1617 -0.0857 0.4091 0.3149  
## 3-1 0.0755 -0.1719 0.3229 0.8486  
## 4-1 0.1153 -0.1321 0.3627 0.6049  
## 3-2 -0.0863 -0.3337 0.1611 0.7900  
## 4-2 -0.0465 -0.2939 0.2010 0.9587  
## 4-3 0.0398 -0.2076 0.2872 0.9733  
##   
## District 4  
## diff lwr upr p adj  
## 2-1 0.1448 -0.0698 0.3594 0.2879  
## 3-1 0.0537 -0.1609 0.2683 0.9093  
## 4-1 0.1137 -0.1009 0.3283 0.4996  
## 3-2 -0.0911 -0.3057 0.1235 0.6733  
## 4-2 -0.0311 -0.2458 0.1835 0.9802  
## 4-3 0.0600 -0.1547 0.2746 0.8790  
##   
## District 5  
## diff lwr upr p adj  
## 2-1 0.1314 -0.0736 0.3364 0.3322  
## 3-1 0.0947 -0.1103 0.2997 0.6113  
## 4-1 0.1980 -0.0070 0.4030 0.0619  
## 3-2 -0.0366 -0.2416 0.1684 0.9641  
## 4-2 0.0666 -0.1384 0.2716 0.8229  
## 4-3 0.1032 -0.1018 0.3082 0.5425  
##   
## District 6  
## diff lwr upr p adj  
## 2-1 0.3055 -0.0914 0.7025 0.1849  
## 3-1 0.3116 -0.0853 0.7085 0.1712  
## 4-1 0.3553 -0.0416 0.7523 0.0942  
## 3-2 0.0061 -0.3909 0.4030 1.0000  
## 4-2 0.0498 -0.3471 0.4467 0.9870  
## 4-3 0.0437 -0.3532 0.4407 0.9911  
##   
## District 7  
## diff lwr upr p adj  
## 2-1 0.2548 -0.0311 0.5407 0.0963  
## 3-1 0.2375 -0.0484 0.5234 0.1348  
## 4-1 0.1392 -0.1467 0.4251 0.5701  
## 3-2 -0.0173 -0.3032 0.2686 0.9985  
## 4-2 -0.1156 -0.4016 0.1703 0.7054  
## 4-3 -0.0983 -0.3842 0.1876 0.7968  
##   
## District 8  
## diff lwr upr p adj  
## 2-1 0.1606 -0.1541 0.4754 0.5313  
## 3-1 0.1582 -0.1566 0.4729 0.5441  
## 4-1 0.2454 -0.0693 0.5602 0.1759  
## 3-2 -0.0024 -0.3172 0.3123 1.0000  
## 4-2 0.0848 -0.2300 0.3996 0.8899  
## 4-3 0.0872 -0.2275 0.4020 0.8815  
##   
## District 9  
## diff lwr upr p adj  
## 2-1 0.1411 -0.2480 0.5303 0.7698  
## 3-1 0.0924 -0.2967 0.4816 0.9212  
## 4-1 0.1412 -0.2479 0.5304 0.7694  
## 3-2 -0.0487 -0.4379 0.3405 0.9871  
## 4-2 0.0001 -0.3891 0.3893 1.0000  
## 4-3 0.0488 -0.3404 0.4380 0.9870  
##   
## District 10  
## diff lwr upr p adj  
## 2-1 0.1425 -0.2201 0.5051 0.7235  
## 3-1 0.2550 -0.1077 0.6176 0.2539  
## 4-1 -0.1485 -0.5111 0.2141 0.6974  
## 3-2 0.1125 -0.2502 0.4751 0.8422  
## 4-2 -0.2910 -0.6536 0.0716 0.1565  
## 4-3 -0.4035 -0.7661 -0.0408 0.0238  
##   
## District 11  
## diff lwr upr p adj  
## 2-1 0.1811 -0.0577 0.4199 0.1957  
## 3-1 0.1558 -0.0830 0.3946 0.3165  
## 4-1 0.1650 -0.0738 0.4038 0.2683  
## 3-2 -0.0253 -0.2641 0.2136 0.9921  
## 4-2 -0.0161 -0.2549 0.2227 0.9979  
## 4-3 0.0092 -0.2297 0.2480 0.9996  
##   
## District 12  
## diff lwr upr p adj  
## 2-1 0.0884 -0.2967 0.4736 0.9281  
## 3-1 0.0852 -0.3000 0.4704 0.9351  
## 4-1 0.0695 -0.3157 0.4547 0.9631  
## 3-2 -0.0033 -0.3884 0.3819 1.0000  
## 4-2 -0.0190 -0.4041 0.3662 0.9992  
## 4-3 -0.0157 -0.4009 0.3695 0.9995  
##   
## District 13  
## diff lwr upr p adj  
## 2-1 0.2457 0.0214 0.4700 0.0267  
## 3-1 0.1391 -0.0852 0.3634 0.3607  
## 4-1 0.2158 -0.0085 0.4401 0.0632  
## 3-2 -0.1066 -0.3308 0.1177 0.5896  
## 4-2 -0.0299 -0.2541 0.1944 0.9846  
## 4-3 0.0767 -0.1476 0.3010 0.7995  
##   
## District 14  
## diff lwr upr p adj  
## 2-1 0.1901 -0.0970 0.4772 0.3040  
## 3-1 0.1167 -0.1705 0.4038 0.7025  
## 4-1 0.2128 -0.0744 0.4999 0.2128  
## 3-2 -0.0734 -0.3606 0.2137 0.9039  
## 4-2 0.0227 -0.2645 0.3098 0.9967  
## 4-3 0.0961 -0.1910 0.3832 0.8096  
##   
## District 15  
## diff lwr upr p adj  
## 2-1 0.2497 -0.1761 0.6754 0.4104  
## 3-1 -0.0380 -0.4638 0.3877 0.9952  
## 4-1 0.4633 0.0376 0.8890 0.0281  
## 3-2 -0.2877 -0.7134 0.1380 0.2866  
## 4-2 0.2136 -0.2121 0.6394 0.5454  
## 4-3 0.5013 0.0756 0.9271 0.0151  
##   
## District 16  
## diff lwr upr p adj  
## 2-1 0.1046 -0.1389 0.3480 0.6650  
## 3-1 0.0842 -0.1593 0.3277 0.7941  
## 4-1 0.1416 -0.1018 0.3851 0.4174  
## 3-2 -0.0204 -0.2638 0.2231 0.9961  
## 4-2 0.0371 -0.2064 0.2805 0.9772  
## 4-3 0.0574 -0.1860 0.3009 0.9226  
##   
## District 17  
## diff lwr upr p adj  
## 2-1 0.1844 -0.0589 0.4278 0.1961  
## 3-1 0.0394 -0.2040 0.2827 0.9730  
## 4-1 0.1440 -0.0993 0.3874 0.4022  
## 3-2 -0.1451 -0.3884 0.0983 0.3958  
## 4-2 -0.0404 -0.2838 0.2029 0.9708  
## 4-3 0.1047 -0.1387 0.3480 0.6640  
##   
## District 18  
## diff lwr upr p adj  
## 2-1 0.1079 -0.1117 0.3276 0.5627  
## 3-1 0.1051 -0.1146 0.3247 0.5842  
## 4-1 0.1543 -0.0654 0.3739 0.2548  
## 3-2 -0.0028 -0.2225 0.2168 1.0000  
## 4-2 0.0463 -0.1733 0.2660 0.9429  
## 4-3 0.0492 -0.1705 0.2688 0.9328  
##   
## District 19  
## diff lwr upr p adj  
## 2-1 0.2300 -0.0384 0.4985 0.1169  
## 3-1 0.0812 -0.1872 0.3497 0.8516  
## 4-1 0.3142 0.0457 0.5826 0.0159  
## 3-2 -0.1488 -0.4173 0.1196 0.4601  
## 4-2 0.0841 -0.1843 0.3526 0.8381  
## 4-3 0.2329 -0.0355 0.5014 0.1101  
##   
## District 20  
## diff lwr upr p adj  
## 2-1 0.1195 -0.1208 0.3598 0.5529  
## 3-1 0.0272 -0.2132 0.2675 0.9904  
## 4-1 0.0350 -0.2054 0.2753 0.9801  
## 3-2 -0.0923 -0.3327 0.1480 0.7372  
## 4-2 -0.0845 -0.3249 0.1558 0.7856  
## 4-3 0.0078 -0.2326 0.2481 0.9998  
##   
## District 21  
## diff lwr upr p adj  
## 2-1 0.1169 -0.0628 0.2965 0.3189  
## 3-1 0.0957 -0.0839 0.2754 0.4943  
## 4-1 0.1064 -0.0732 0.2861 0.4011  
## 3-2 -0.0211 -0.2008 0.1585 0.9892  
## 4-2 -0.0104 -0.1901 0.1692 0.9987  
## 4-3 0.0107 -0.1689 0.1903 0.9986  
##   
## District 22  
## diff lwr upr p adj  
## 2-1 0.2583 -0.0624 0.5789 0.1541  
## 3-1 0.2112 -0.1095 0.5318 0.3084  
## 4-1 0.1050 -0.2157 0.4256 0.8196  
## 3-2 -0.0471 -0.3677 0.2736 0.9795  
## 4-2 -0.1533 -0.4740 0.1673 0.5846  
## 4-3 -0.1062 -0.4269 0.2144 0.8144  
##   
## District 23  
## diff lwr upr p adj  
## 2-1 -0.0427 -0.2577 0.1723 0.9518  
## 3-1 -0.0428 -0.2578 0.1722 0.9514  
## 4-1 0.0691 -0.1459 0.2841 0.8277  
## 3-2 -0.0001 -0.2151 0.2149 1.0000  
## 4-2 0.1118 -0.1032 0.3268 0.5157  
## 4-3 0.1119 -0.1031 0.3269 0.5149  
##   
## District 24  
## diff lwr upr p adj  
## 2-1 0.1945 -0.0451 0.4340 0.1493  
## 3-1 0.0830 -0.1566 0.3226 0.7933  
## 4-1 0.2112 -0.0284 0.4508 0.1018  
## 3-2 -0.1115 -0.3511 0.1281 0.6062  
## 4-2 0.0168 -0.2228 0.2564 0.9977  
## 4-3 0.1282 -0.1114 0.3678 0.4906  
##   
## District 25  
## diff lwr upr p adj  
## 2-1 0.0324 -0.1898 0.2546 0.9800  
## 3-1 -0.0242 -0.2464 0.1981 0.9915  
## 4-1 0.2216 -0.0006 0.4438 0.0509  
## 3-2 -0.0565 -0.2787 0.1657 0.9054  
## 4-2 0.1892 -0.0330 0.4114 0.1205  
## 4-3 0.2457 0.0235 0.4679 0.0249  
##   
## District 26  
## diff lwr upr p adj  
## 2-1 0.2089 -0.0159 0.4337 0.0772  
## 3-1 0.1552 -0.0696 0.3800 0.2689  
## 4-1 0.2429 0.0181 0.4678 0.0295  
## 3-2 -0.0537 -0.2785 0.1711 0.9200  
## 4-2 0.0340 -0.1908 0.2589 0.9776  
## 4-3 0.0877 -0.1371 0.3126 0.7277  
##   
## District 27  
## diff lwr upr p adj  
## 2-1 0.2742 -0.0032 0.5516 0.0538  
## 3-1 0.2137 -0.0637 0.4911 0.1843  
## 4-1 0.1929 -0.0845 0.4703 0.2628  
## 3-2 -0.0605 -0.3379 0.2169 0.9375  
## 4-2 -0.0813 -0.3586 0.1961 0.8632  
## 4-3 -0.0208 -0.2982 0.2566 0.9972  
##   
## District 28  
## diff lwr upr p adj  
## 2-1 0.1068 -0.1282 0.3418 0.6240  
## 3-1 0.0505 -0.1845 0.2855 0.9400  
## 4-1 0.0753 -0.1597 0.3103 0.8288  
## 3-2 -0.0563 -0.2913 0.1787 0.9193  
## 4-2 -0.0315 -0.2665 0.2035 0.9843  
## 4-3 0.0248 -0.2102 0.2598 0.9922  
##   
## District 29  
## diff lwr upr p adj  
## 2-1 0.0789 -0.3723 0.5300 0.9663  
## 3-1 0.0468 -0.4044 0.4979 0.9926  
## 4-1 0.0677 -0.3835 0.5188 0.9782  
## 3-2 -0.0321 -0.4832 0.4191 0.9976  
## 4-2 -0.0112 -0.4623 0.4400 0.9999  
## 4-3 0.0209 -0.4302 0.4720 0.9993  
##   
## District 30  
## diff lwr upr p adj  
## 2-1 0.1970 0.0013 0.3927 0.0480  
## 3-1 0.0978 -0.0979 0.2935 0.5488  
## 4-1 0.1088 -0.0869 0.3045 0.4576  
## 3-2 -0.0992 -0.2949 0.0965 0.5373  
## 4-2 -0.0882 -0.2839 0.1075 0.6305  
## 4-3 0.0110 -0.1847 0.2067 0.9988  
##   
## District 31  
## diff lwr upr p adj  
## 2-1 0.1164 -0.0910 0.3238 0.4489  
## 3-1 0.1063 -0.1011 0.3136 0.5278  
## 4-1 0.0837 -0.1237 0.2911 0.7066  
## 3-2 -0.0102 -0.2175 0.1972 0.9992  
## 4-2 -0.0327 -0.2401 0.1747 0.9749  
## 4-3 -0.0225 -0.2299 0.1848 0.9914  
##   
## District 32  
## diff lwr upr p adj  
## 2-1 0.0806 -0.1803 0.3415 0.8436  
## 3-1 0.0431 -0.2178 0.3040 0.9712  
## 4-1 0.0997 -0.1612 0.3606 0.7402  
## 3-2 -0.0375 -0.2984 0.2234 0.9808  
## 4-2 0.0191 -0.2418 0.2800 0.9973  
## 4-3 0.0566 -0.2043 0.3175 0.9384  
##   
## District 33  
## diff lwr upr p adj  
## 2-1 0.1881 -0.0148 0.3910 0.0782  
## 3-1 0.1842 -0.0187 0.3871 0.0875  
## 4-1 0.1910 -0.0119 0.3939 0.0719  
## 3-2 -0.0039 -0.2068 0.1990 1.0000  
## 4-2 0.0029 -0.2000 0.2058 1.0000  
## 4-3 0.0067 -0.1962 0.2097 0.9997  
##   
## District 34  
## diff lwr upr p adj  
## 2-1 0.3674 -0.0080 0.7429 0.0572  
## 3-1 0.3092 -0.0662 0.6847 0.1401  
## 4-1 0.2600 -0.1155 0.6354 0.2663  
## 3-2 -0.0582 -0.4336 0.3172 0.9760  
## 4-2 -0.1074 -0.4829 0.2680 0.8712  
## 4-3 -0.0492 -0.4247 0.3262 0.9852  
##   
## District 35  
## diff lwr upr p adj  
## 2-1 0.2081 -0.0714 0.4875 0.2091  
## 3-1 0.1577 -0.1218 0.4371 0.4445  
## 4-1 0.1651 -0.1144 0.4445 0.4039  
## 3-2 -0.0504 -0.3299 0.2290 0.9631  
## 4-2 -0.0430 -0.3225 0.2365 0.9765  
## 4-3 0.0074 -0.2721 0.2869 0.9999

# Total Waste Generation

## Total Waste Quarterly Comparison

Divide data into 4 quarters: 1 (week1-13), 2 (week14-26), 3 (week27-39), 4 (week40-52) Compare all possible quarter comparison on Waste Generation rates. ### All Districts combined

round(TukeyHSD(aov(Waste\_Gen\_lbsHHd ~ Quarter, data=data2017))$Quarter,4)

## diff lwr upr p adj  
## 2-1 2.0801 1.8553 2.3049 0  
## 3-1 1.6012 1.3764 1.8260 0  
## 4-1 1.1157 0.8909 1.3405 0  
## 3-2 -0.4789 -0.7037 -0.2541 0  
## 4-2 -0.9644 -1.1892 -0.7396 0  
## 4-3 -0.4855 -0.7103 -0.2607 0

### Each district

Compare all possible quarter comparison on Waste Generation rates for each district.

for(i in 1:35) {  
 cat(paste0("\n District ", i))  
 cat("\n")  
 print(  
 round(  
 TukeyHSD(aov(data2017$Waste\_Gen\_lbsHHd[data2017$District == i] ~ data2017$Quarter[data2017$District == i]))$`data2017$Quarter[data2017$District == i]`,  
 4)  
 )  
}

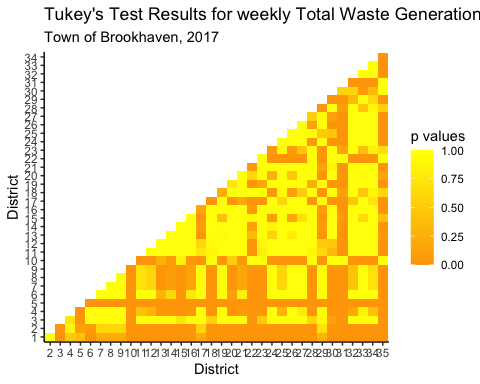
##   
## District 1  
## diff lwr upr p adj  
## 2-1 2.2560 1.3199 3.1922 0.0000  
## 3-1 1.8590 0.9228 2.7952 0.0000  
## 4-1 1.0478 0.1116 1.9840 0.0227  
## 3-2 -0.3970 -1.3332 0.5392 0.6739  
## 4-2 -1.2083 -2.1444 -0.2721 0.0065  
## 4-3 -0.8113 -1.7474 0.1249 0.1108  
##   
## District 2  
## diff lwr upr p adj  
## 2-1 1.8505 0.8784 2.8225 0.0000  
## 3-1 1.2231 0.2511 2.1952 0.0083  
## 4-1 1.2899 0.3178 2.2620 0.0050  
## 3-2 -0.6273 -1.5994 0.3448 0.3260  
## 4-2 -0.5605 -1.5326 0.4115 0.4253  
## 4-3 0.0668 -0.9053 1.0389 0.9978  
##   
## District 3  
## diff lwr upr p adj  
## 2-1 2.1218 1.0030 3.2406 0.0000  
## 3-1 1.4862 0.3674 2.6050 0.0049  
## 4-1 1.5960 0.4772 2.7148 0.0023  
## 3-2 -0.6356 -1.7544 0.4832 0.4385  
## 4-2 -0.5258 -1.6446 0.5930 0.5981  
## 4-3 0.1098 -1.0090 1.2286 0.9937  
##   
## District 4  
## diff lwr upr p adj  
## 2-1 1.8060 0.9493 2.6627 0.0000  
## 3-1 1.5382 0.6815 2.3949 0.0001  
## 4-1 1.0590 0.2023 1.9158 0.0098  
## 3-2 -0.2678 -1.1245 0.5889 0.8391  
## 4-2 -0.7470 -1.6037 0.1097 0.1076  
## 4-3 -0.4792 -1.3359 0.3775 0.4522  
##   
## District 5  
## diff lwr upr p adj  
## 2-1 1.7183 0.8827 2.5540 0.0000  
## 3-1 1.3790 0.5434 2.2146 0.0003  
## 4-1 1.0285 0.1928 1.8641 0.0102  
## 3-2 -0.3393 -1.1750 0.4963 0.7028  
## 4-2 -0.6899 -1.5255 0.1458 0.1386  
## 4-3 -0.3505 -1.1862 0.4851 0.6813  
##   
## District 6  
## diff lwr upr p adj  
## 2-1 1.9127 0.8870 2.9383 0.0001  
## 3-1 1.6097 0.5840 2.6354 0.0007  
## 4-1 0.8936 -0.1320 1.9193 0.1079  
## 3-2 -0.3030 -1.3286 0.7227 0.8604  
## 4-2 -1.0190 -2.0447 0.0067 0.0521  
## 4-3 -0.7161 -1.7417 0.3096 0.2597  
##   
## District 7  
## diff lwr upr p adj  
## 2-1 2.0224 0.9389 3.1060 0.0001  
## 3-1 1.4529 0.3694 2.5364 0.0044  
## 4-1 0.5696 -0.5139 1.6532 0.5061  
## 3-2 -0.5695 -1.6531 0.5140 0.5062  
## 4-2 -1.4528 -2.5363 -0.3692 0.0045  
## 4-3 -0.8833 -1.9668 0.2003 0.1465  
##   
## District 8  
## diff lwr upr p adj  
## 2-1 1.4544 -0.0962 3.0050 0.0733  
## 3-1 1.3008 -0.2498 2.8514 0.1290  
## 4-1 1.3965 -0.1541 2.9471 0.0913  
## 3-2 -0.1536 -1.7042 1.3970 0.9935  
## 4-2 -0.0579 -1.6085 1.4927 0.9996  
## 4-3 0.0957 -1.4549 1.6463 0.9984  
##   
## District 9  
## diff lwr upr p adj  
## 2-1 1.3184 0.0241 2.6126 0.0444  
## 3-1 1.5529 0.2586 2.8472 0.0128  
## 4-1 0.5360 -0.7583 1.8302 0.6900  
## 3-2 0.2345 -1.0597 1.5288 0.9627  
## 4-2 -0.7824 -2.0767 0.5119 0.3834  
## 4-3 -1.0169 -2.3112 0.2773 0.1706  
##   
## District 10  
## diff lwr upr p adj  
## 2-1 2.7347 1.5736 3.8959 0.0000  
## 3-1 1.6584 0.4973 2.8195 0.0022  
## 4-1 0.8253 -0.3359 1.9864 0.2452  
## 3-2 -1.0763 -2.2375 0.0848 0.0783  
## 4-2 -1.9095 -3.0706 -0.7483 0.0004  
## 4-3 -0.8331 -1.9943 0.3280 0.2377  
##   
## District 11  
## diff lwr upr p adj  
## 2-1 2.0424 1.1427 2.9422 0.0000  
## 3-1 1.5131 0.6134 2.4129 0.0003  
## 4-1 0.8775 -0.0222 1.7773 0.0584  
## 3-2 -0.5293 -1.4290 0.3705 0.4076  
## 4-2 -1.1649 -2.0646 -0.2651 0.0063  
## 4-3 -0.6356 -1.5353 0.2642 0.2501  
##   
## District 12  
## diff lwr upr p adj  
## 2-1 2.1859 0.9573 3.4145 0.0001  
## 3-1 1.7337 0.5051 2.9623 0.0026  
## 4-1 0.7218 -0.5068 1.9503 0.4088  
## 3-2 -0.4522 -1.6808 0.7764 0.7617  
## 4-2 -1.4642 -2.6927 -0.2356 0.0136  
## 4-3 -1.0120 -2.2405 0.2166 0.1400  
##   
## District 13  
## diff lwr upr p adj  
## 2-1 2.0960 1.1012 3.0907 0.0000  
## 3-1 1.5790 0.5843 2.5738 0.0006  
## 4-1 1.0871 0.0923 2.0818 0.0272  
## 3-2 -0.5169 -1.5117 0.4778 0.5160  
## 4-2 -1.0089 -2.0037 -0.0142 0.0457  
## 4-3 -0.4920 -1.4867 0.5028 0.5573  
##   
## District 14  
## diff lwr upr p adj  
## 2-1 2.4334 1.4930 3.3738 0.0000  
## 3-1 1.7458 0.8054 2.6862 0.0001  
## 4-1 1.3117 0.3713 2.2521 0.0029  
## 3-2 -0.6875 -1.6279 0.2528 0.2230  
## 4-2 -1.1217 -2.0620 -0.1813 0.0135  
## 4-3 -0.4341 -1.3745 0.5063 0.6120  
##   
## District 15  
## diff lwr upr p adj  
## 2-1 2.9721 1.5168 4.4274 0.0000  
## 3-1 2.0533 0.5980 3.5086 0.0026  
## 4-1 1.5893 0.1340 3.0447 0.0273  
## 3-2 -0.9188 -2.3741 0.5365 0.3452  
## 4-2 -1.3828 -2.8381 0.0725 0.0681  
## 4-3 -0.4640 -1.9193 0.9913 0.8310  
##   
## District 16  
## diff lwr upr p adj  
## 2-1 2.1472 1.0357 3.2588 0.0000  
## 3-1 1.8029 0.6913 2.9144 0.0004  
## 4-1 1.1861 0.0745 2.2976 0.0323  
## 3-2 -0.3444 -1.4559 0.7672 0.8426  
## 4-2 -0.9612 -2.0727 0.1504 0.1120  
## 4-3 -0.6168 -1.7283 0.4948 0.4592  
##   
## District 17  
## diff lwr upr p adj  
## 2-1 1.6019 0.6725 2.5313 0.0002  
## 3-1 1.1630 0.2336 2.0924 0.0088  
## 4-1 0.9925 0.0631 1.9218 0.0322  
## 3-2 -0.4389 -1.3683 0.4905 0.5944  
## 4-2 -0.6094 -1.5388 0.3199 0.3122  
## 4-3 -0.1705 -1.0999 0.7588 0.9613  
##   
## District 18  
## diff lwr upr p adj  
## 2-1 1.9960 1.0853 2.9067 0.0000  
## 3-1 1.9320 1.0214 2.8427 0.0000  
## 4-1 1.3553 0.4446 2.2660 0.0014  
## 3-2 -0.0640 -0.9746 0.8467 0.9977  
## 4-2 -0.6407 -1.5514 0.2700 0.2534  
## 4-3 -0.5767 -1.4874 0.3339 0.3424  
##   
## District 19  
## diff lwr upr p adj  
## 2-1 2.5766 1.2506 3.9025 0.0000  
## 3-1 1.4932 0.1672 2.8191 0.0217  
## 4-1 2.5641 1.2381 3.8901 0.0000  
## 3-2 -1.0834 -2.4094 0.2426 0.1450  
## 4-2 -0.0125 -1.3384 1.3135 1.0000  
## 4-3 1.0709 -0.2550 2.3969 0.1524  
##   
## District 20  
## diff lwr upr p adj  
## 2-1 1.8756 0.7827 2.9685 0.0002  
## 3-1 1.0716 -0.0213 2.1645 0.0565  
## 4-1 0.2554 -0.8374 1.3483 0.9245  
## 3-2 -0.8040 -1.8969 0.2889 0.2183  
## 4-2 -1.6202 -2.7130 -0.5273 0.0014  
## 4-3 -0.8162 -1.9090 0.2767 0.2069  
##   
## District 21  
## diff lwr upr p adj  
## 2-1 1.9566 1.1089 2.8043 0.0000  
## 3-1 1.2896 0.4419 2.1374 0.0010  
## 4-1 0.7234 -0.1243 1.5711 0.1192  
## 3-2 -0.6670 -1.5147 0.1807 0.1697  
## 4-2 -1.2332 -2.0809 -0.3855 0.0018  
## 4-3 -0.5662 -1.4139 0.2815 0.2965  
##   
## District 22  
## diff lwr upr p adj  
## 2-1 2.9977 1.2846 4.7108 0.0001  
## 3-1 2.8996 1.1865 4.6127 0.0002  
## 4-1 1.5889 -0.1242 3.3020 0.0780  
## 3-2 -0.0981 -1.8112 1.6150 0.9987  
## 4-2 -1.4087 -3.1218 0.3044 0.1410  
## 4-3 -1.3107 -3.0238 0.4024 0.1892  
##   
## District 23  
## diff lwr upr p adj  
## 2-1 1.5081 0.5729 2.4433 0.0005  
## 3-1 1.0485 0.1133 1.9837 0.0224  
## 4-1 0.5677 -0.3674 1.5029 0.3797  
## 3-2 -0.4596 -1.3948 0.4756 0.5624  
## 4-2 -0.9404 -1.8755 -0.0052 0.0483  
## 4-3 -0.4807 -1.4159 0.4544 0.5251  
##   
## District 24  
## diff lwr upr p adj  
## 2-1 2.6140 1.3243 3.9038 0.0000  
## 3-1 2.0238 0.7340 3.3135 0.0007  
## 4-1 1.9803 0.6905 3.2701 0.0009  
## 3-2 -0.5903 -1.8801 0.6995 0.6186  
## 4-2 -0.6337 -1.9235 0.6560 0.5627  
## 4-3 -0.0434 -1.3332 1.2463 0.9997  
##   
## District 25  
## diff lwr upr p adj  
## 2-1 1.1807 0.2800 2.0813 0.0056  
## 3-1 0.9623 0.0617 1.8630 0.0320  
## 4-1 0.8585 -0.0422 1.7591 0.0669  
## 3-2 -0.2183 -1.1190 0.6823 0.9167  
## 4-2 -0.3222 -1.2228 0.5785 0.7770  
## 4-3 -0.1038 -1.0045 0.7968 0.9899  
##   
## District 26  
## diff lwr upr p adj  
## 2-1 1.8477 1.0194 2.6760 0.0000  
## 3-1 1.3934 0.5651 2.2217 0.0003  
## 4-1 1.1773 0.3490 2.0056 0.0024  
## 3-2 -0.4544 -1.2827 0.3739 0.4693  
## 4-2 -0.6704 -1.4987 0.1579 0.1510  
## 4-3 -0.2161 -1.0444 0.6122 0.8988  
##   
## District 27  
## diff lwr upr p adj  
## 2-1 1.8313 0.9225 2.7400 0.0000  
## 3-1 1.4096 0.5009 2.3184 0.0008  
## 4-1 1.0290 0.1202 1.9377 0.0207  
## 3-2 -0.4216 -1.3304 0.4871 0.6082  
## 4-2 -0.8023 -1.7110 0.1065 0.1011  
## 4-3 -0.3807 -1.2894 0.5281 0.6823  
##   
## District 28  
## diff lwr upr p adj  
## 2-1 2.1582 1.1162 3.2003 0.0000  
## 3-1 1.9388 0.8968 2.9809 0.0001  
## 4-1 1.1656 0.1236 2.2077 0.0228  
## 3-2 -0.2194 -1.2615 0.8227 0.9433  
## 4-2 -0.9926 -2.0347 0.0495 0.0671  
## 4-3 -0.7732 -1.8153 0.2689 0.2118  
##   
## District 29  
## diff lwr upr p adj  
## 2-1 2.5094 1.3010 3.7178 0.0000  
## 3-1 1.9791 0.7707 3.1875 0.0004  
## 4-1 1.2920 0.0836 2.5004 0.0319  
## 3-2 -0.5303 -1.7387 0.6781 0.6497  
## 4-2 -1.2174 -2.4258 -0.0090 0.0477  
## 4-3 -0.6871 -1.8955 0.5213 0.4377  
##   
## District 30  
## diff lwr upr p adj  
## 2-1 2.2860 1.3391 3.2330 0.0000  
## 3-1 1.6644 0.7174 2.6113 0.0001  
## 4-1 1.1527 0.2058 2.0997 0.0113  
## 3-2 -0.6217 -1.5686 0.3253 0.3112  
## 4-2 -1.1333 -2.0802 -0.1864 0.0131  
## 4-3 -0.5116 -1.4586 0.4353 0.4825  
##   
## District 31  
## diff lwr upr p adj  
## 2-1 2.4993 1.4469 3.5517 0.0000  
## 3-1 1.8241 0.7717 2.8765 0.0002  
## 4-1 1.1198 0.0674 2.1722 0.0330  
## 3-2 -0.6752 -1.7276 0.3772 0.3311  
## 4-2 -1.3795 -2.4319 -0.3271 0.0056  
## 4-3 -0.7043 -1.7567 0.3481 0.2949  
##   
## District 32  
## diff lwr upr p adj  
## 2-1 2.0936 1.0887 3.0985 0.0000  
## 3-1 1.0600 0.0551 2.0649 0.0351  
## 4-1 0.9666 -0.0383 1.9715 0.0634  
## 3-2 -1.0336 -2.0385 -0.0287 0.0417  
## 4-2 -1.1269 -2.1318 -0.1220 0.0224  
## 4-3 -0.0934 -1.0983 0.9115 0.9946  
##   
## District 33  
## diff lwr upr p adj  
## 2-1 1.4580 0.4504 2.4656 0.0019  
## 3-1 1.4239 0.4163 2.4315 0.0025  
## 4-1 0.6202 -0.3874 1.6278 0.3675  
## 3-2 -0.0341 -1.0417 0.9735 0.9997  
## 4-2 -0.8378 -1.8454 0.1698 0.1343  
## 4-3 -0.8037 -1.8113 0.2039 0.1605  
##   
## District 34  
## diff lwr upr p adj  
## 2-1 2.7437 1.6200 3.8675 0.0000  
## 3-1 2.1773 1.0535 3.3010 0.0000  
## 4-1 1.4129 0.2892 2.5366 0.0084  
## 3-2 -0.5665 -1.6902 0.5573 0.5415  
## 4-2 -1.3308 -2.4546 -0.2071 0.0144  
## 4-3 -0.7644 -1.8881 0.3594 0.2812  
##   
## District 35  
## diff lwr upr p adj  
## 2-1 1.9966 0.8823 3.1110 0.0001  
## 3-1 1.7996 0.6852 2.9139 0.0005  
## 4-1 1.2106 0.0963 2.3250 0.0284  
## 3-2 -0.1970 -1.3114 0.9173 0.9652  
## 4-2 -0.7860 -1.9003 0.3284 0.2514  
## 4-3 -0.5889 -1.7033 0.5254 0.5016

## Total Waste Geographic Comparison

### District Comparisons

Compare total waste generation rates (lbs/HH/d) for all possible combinations of 35 districts.

ano5 <- aov(Waste\_Gen\_lbsHHd ~ District, data=data2017)  
  
tukey5 <- TukeyHSD(ano5)  
tukey5\_districts <- as\_tibble(tukey5$District)  
tukey5\_districts$District\_Pair <- rownames(tukey5$District)  
tukey5\_districts$`p adj` <- round(tukey5\_districts$`p adj`, 3)  
  
tukey5\_districts$District\_X <- as\_factor(sub("\\-.\*", "", tukey5\_districts$District\_Pair))  
tukey5\_districts$District\_Y <- as\_factor(sub(".\*\\-", "", tukey5\_districts$District\_Pair))  
  
tukey5\_districts %>%  
 ggplot(aes(District\_X, District\_Y, fill= `p adj`)) +   
 geom\_tile() +  
 labs(x="District", y="District", fill="p values") +  
 ggtitle("Tukey's Test Results for weekly Total Waste Generation rates (lbs/HH/d)", subtitle = "Town of Brookhaven, 2017") +  
 theme\_classic() +  
 scale\_fill\_gradient(low = "orange", high = "yellow")



### Region Comparisons

Compare total waste generation rates (lbs/HH/d) for all possible combinations of 3 regions.

ano6 <- aov(Waste\_Gen\_lbsHHd ~ Region, data=data2017)  
summary(ano6)

## Df Sum Sq Mean Sq F value Pr(>F)   
## Region 2 554 276.94 136.5 <2e-16 \*\*\*  
## Residuals 1817 3688 2.03   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

dunn.test(data2017$Waste\_Gen\_lbsHHd, g=data2017$Region, method="bonferroni") #dunn test bonferroni

## Kruskal-Wallis rank sum test  
##   
## data: x and group  
## Kruskal-Wallis chi-squared = 264.8479, df = 2, p-value = 0  
##   
##   
## Comparison of x by group   
## (Bonferroni)   
## Col Mean-|  
## Row Mean | middle north  
## ---------+----------------------  
## north | 14.93562  
## | 0.0000\*  
## |  
## south | 0.020554 -13.99270  
## | 1.0000 0.0000\*  
##   
## alpha = 0.05  
## Reject Ho if p <= alpha/2

tukey6 <- TukeyHSD(ano6)  
tukey6\_regions <- as\_tibble(tukey6$Region)  
tukey6\_regions$Region\_Pair <- rownames(tukey6$Region)  
tukey6\_regions$`p adj` <- round(tukey6\_regions$`p adj`, 3)  
print(tukey6\_regions)

## # A tibble: 3 × 5  
## diff lwr upr `p adj` Region\_Pair   
## <dbl> <dbl> <dbl> <dbl> <chr>   
## 1 -1.27 -1.46 -1.07 0 north-middle  
## 2 -0.0101 -0.194 0.174 0.991 south-middle  
## 3 1.26 1.05 1.46 0 south-north

Visualization for region comparisons (Total Waste Generation).

tukey6\_regions$Region\_X <- as\_factor(sub("\\-.\*", "", tukey6\_regions$Region\_Pair))  
tukey6\_regions$Region\_Y <- as\_factor(sub(".\*\\-", "", tukey6\_regions$Region\_Pair))  
  
tukey6\_regions %>%  
 ggplot(aes(Region\_X, Region\_Y, fill= `p adj`)) +   
 geom\_tile() +  
 labs(x="Region", y="Region", fill="p values") +  
 ggtitle("Tukey's Test Results for weekly Total Waste Generation rates (lbs/HH/dd)", subtitle = "Town of Brookhaven, 2017") +  
 theme\_classic() +  
 scale\_fill\_gradient(low = "orange", high = "yellow")

