SCDL3991: Google Trends Study Verification (Meth Analysis)

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```
library(tidyverse)
setwd('/Users/natan/Desktop/usyd/2022/sem 2/scdl3991/meth paper analysis')
global_monthly = read_csv("All countries global monthly.csv")
regional_monthly = read_csv("All countries regional monthly.csv")
```

Global Data

Switzerland

```
library(tidyverse)
library(ggplot2)
library(ggrepel)
global_monthly_switzerland <- global_monthly |> filter(ccode == 'CH') |> select(-c(firstusers_cmet

global_monthly_switzerland <- global_monthly_switzerland |> group_by(year) |> mutate(meth_avg = me
global_monthly_switzerland$date<-as.Date(with(global_monthly_switzerland,paste(year,month,day,sep=

switzerland_plot = ggplot(global_monthly_switzerland, aes(x=date, ))+
  geom_line(aes(col = 'All Offences',y = all_offences)) +
  labs(y = 'N',x = '') +
  geom_line(aes(col = 'Dealing',y = offences_handel_gesamt)) +
  geom_line(aes(col = 'Use',y = offences_konsum_gesamt))+
  geom_line(alpha = 0.3,aes(y = meth, col = 'Meth')) +
  geom_line(aes(y = meth_avg))+
  scale_color_manual(name = "", values = c("All Offences" = "darkblue", "Dealing" = "red", "Use" =
```

Germany

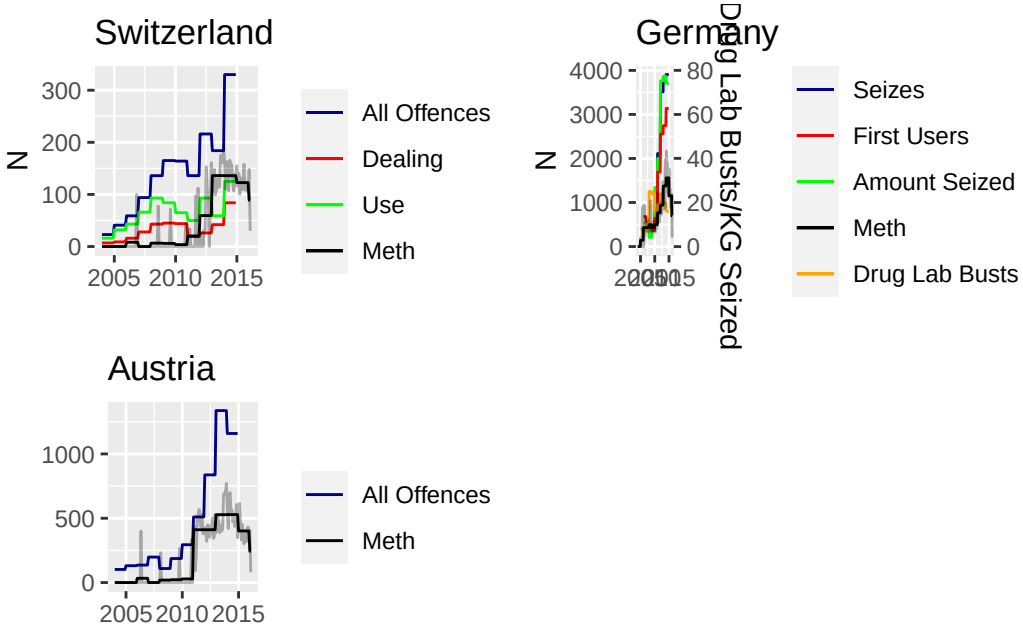
```
library(tidyverse)
library(ggplot2)
library(ggrepel)
global_monthly_germany <- global_monthly |> filter(ccode == 'DE') |> select(c(firstusers_cmeth_DE,

global_monthly_germany <- global_monthly_germany |> group_by(year) |> mutate(meth2 = mean(meth))
global_monthly_germany$date<-as.Date(with(global_monthly_germany,paste(year,month,day,sep="-")),"%

germany_plot = ggplot(global_monthly_germany, aes(x=date, ))+
  geom_line(aes(col = 'Seizes',y = nseizes_cmeth_DE)) +
  labs(y = '',x = '') +
  geom_line(aes(col = 'Amount Seized',y = kg_cmeth_DE*50)) +
  geom_line(aes(col = 'First Users',y = firstusers_cmeth_DE))+
  geom_line(aes(col = 'Drug Lab Busts',y=druglabbusts_DE*50))+
  geom_line(alpha = 0.3,aes(y = meth*10, col = 'Meth')) + # multiplied by 10 to rescale properly b
  geom_line(aes(y = meth2*10)) +
  scale_color_manual(name = "", values = c("Seizes" = "darkblue", "First Users" = "red", "Amount S
  scale_y_continuous(name = "N",
    sec.axis = sec_axis(~.*0.02, name="N Drug Lab Busts/KG Seized"))+ ggtitle("Germany")
```

Austria

```
library(tidyverse)
library(ggplot2)
library(ggrepel)
global_monthly_austria <- global_monthly |> filter(ccode == 'AT') |> select(c(offences_meth_AT,yea
```

```r
global_monthly_austria <- global_monthly_austria |> group_by(year) |> mutate(meth2 = mean(meth))
global_monthly_austria$date<-as.Date(with(global_monthly_austria,paste(year,month,day,sep="-")),"%

austria_plot = ggplot(global_monthly_austria, aes(x=date, ))+
  labs(y = '',x = '') +
  geom_line(aes(col = 'All Offences',y = offences_meth_AT)) +
  geom_line(alpha = 0.3,aes(y = meth*4, col = 'Meth')) + # multiplied by 10 to rescale properly bu
  geom_line(aes(y = meth2*4)) + ##Again, the value 4 is a very rough estimate based on what they h
  scale_color_manual(name = "", values = c("All Offences" = "darkblue", "Meth" = "black")) +
  ggtitle("Austria")
```

```r
require(gridExtra)
cowplot::plot_grid(switzerland_plot,germany_plot,austria_plot)
```



Regional Data

Austria

```r
library(tidyverse)
library(ggplot2)
library(ggrepel)
regional_monthly_austria <- regional_monthly |> filter(ccode == 'AT') |>    mutate(day= 1) |> filt
regional_monthly_austria1 <- regional_monthly |> filter(ccode == 'AT') |>   mutate(day= 1) |> filt
regional_monthly_austria2 <- regional_monthly |> filter(ccode == 'AT') |>   mutate(day= 1) |> filt
regional_monthly_austria3 <- regional_monthly |> filter(ccode == 'AT') |>   mutate(day= 1) |> filt
```

```r
regional_monthly_austria4 <- regional_monthly |> filter(ccode == 'AT') |>   mutate(day= 1) |> filt
regional_monthly_austria5 <- regional_monthly |> filter(ccode == 'AT') |>   mutate(day= 1) |> filt

regional_monthly_austria$date<-as.Date(with(regional_monthly_austria,paste(year,month,day,sep="-")
regional_monthly_austria1$date<-as.Date(with(regional_monthly_austria1,paste(year,month,day,sep="-
regional_monthly_austria2$date<-as.Date(with(regional_monthly_austria2,paste(year,month,day,sep="-
regional_monthly_austria3$date<-as.Date(with(regional_monthly_austria3,paste(year,month,day,sep="-
regional_monthly_austria4$date<-as.Date(with(regional_monthly_austria4,paste(year,month,day,sep="-
regional_monthly_austria5$date<-as.Date(with(regional_monthly_austria5,paste(year,month,day,sep="-

p = ggplot(regional_monthly_austria, aes(x=date, ))+
  labs(y = '',x = '') +
  geom_line(aes(col = 'All Offences',y = offences_meth_AT)) +
  geom_line(aes(y = meth*4, col = 'Meth')) + # multiplied by 10 to rescale properly but 10 is just
  facet_wrap(vars(region)) +
  theme(legend.position="none") + ylim(0, 800)

p1 = ggplot(regional_monthly_austria1, aes(x=date, ))+
  labs(y = '',x = '') +
  geom_line(aes(col = 'All Offences',y = offences_meth_AT)) +
  geom_line(aes(y = meth*4, col = 'Meth')) +
  facet_wrap(vars(region)) + ylim(0, 800)+ theme(legend.title = element_blank(),legend.position =

p2 =ggplot(regional_monthly_austria2, aes(x=date, ))+
  labs(y = '',x = '') +
  geom_line(aes(col = 'All Offences',y = offences_meth_AT)) +
  geom_line(aes(y = meth*4, col = 'Meth')) +
  facet_wrap(vars(region)) +
  theme(legend.position="none")+ ylim(0, 800)

p3 = ggplot(regional_monthly_austria3, aes(x=date, ))+
  labs(y = '',x = '') +
  geom_line(aes(col = 'All Offences',y = offences_meth_AT)) +
  geom_line(aes(y = meth*4, col = 'Meth')) +
  facet_wrap(vars(region)) +
  theme(legend.position="none")+ ylim(0, 800)

p4=ggplot(regional_monthly_austria4, aes(x=date, ))+
  labs(y = '',x = '') +
  geom_line(aes(col = 'All Offences',y = offences_meth_AT)) +
  geom_line(aes(y = meth*4, col = 'Meth')) +
  facet_wrap(vars(region)) +
  theme(legend.position="none")+ ylim(0, 800)

p5=ggplot(regional_monthly_austria5, aes(x=date, ))+
  labs(y = '',x = '') +
  geom_line(aes(col = 'All Offences',y = offences_meth_AT)) +
  geom_line(aes(y = meth*4, col = 'Meth')) +
  facet_wrap(vars(region)) +theme(legend.position="none")+
```

```
  ylim(0, 800)

require(gridExtra)
grid.arrange(p, p1,p2,p3,p4,p5, ncol=3,nrow=2)
```

Cross Correlation Global Imputed Monthly

Austria

```
library(tidyr)
library(LaplacesDemon)
library(plyr)
library(matrixStats)
library(ggplot2)
dist = rdirichlet(1, c(1,1,1,1,1,1,1,1,1,1,1,1))
global_monthly_austria <-global_monthly_austria |> group_by(year) |> drop_na(offences_meth_AT) |>
n = length(unique(global_monthly_austria$year))
acf_tibble= data.frame(matrix(NA,
                              nrow = 49,
                              ncol = 0))


for (i in 1:100){
  dist = rdirichlet(1, c(1,1,1,1,1,1,1,1,1,1,1,1))
  dist = rep(dist,n)
  global_monthly_austria <- global_monthly_austria %>% add_column(dist*global_monthly_austria$offe
```

```
  ccf_austria = ccf(global_monthly_austria$meth,global_monthly_austria[,ncol(global_monthly_austri
  ccf_austria = ccf_austria$acf
  acf_tibble <- acf_tibble %>% add_column(ccf_austria, .name_repair = "unique")
}

len  = 100
acf_tibble$acf_median = rowMedians(as.matrix(acf_tibble[,c(1:len)]), na.rm =TRUE)
acf_tibble$seventyfifth_percentile = rowQuantiles(as.matrix(acf_tibble[,c(1:len)]), na.rm =TRUE,pr
acf_tibble$twentyfifth_percentile = rowQuantiles(as.matrix(acf_tibble[,c(1:len)]), na.rm =TRUE,pro
acf_tibble$lag = c(-24:24)
p1 = ggplot(acf_tibble, aes(y=acf_median,x = lag ))+ geom_line() +ylim(0, 1) + geom_ribbon(aes(ymi
```

Switzerland

```
library(tidyr)
library(LaplacesDemon)
library(plyr)
library(matrixStats)
library(ggplot2)
dist = rdirichlet(1, c(1,1,1,1,1,1,1,1,1,1,1,1))
global_monthly_switzerland <-global_monthly_switzerland |> group_by(year) |> drop_na(all_offences)
n = length(unique(global_monthly_switzerland$year))

acf_tibble= data.frame(matrix(NA,
                              nrow = 49,
                              ncol = 0))
for (i in 1:100){
  dist = rdirichlet(1, c(1,1,1,1,1,1,1,1,1,1,1,1))
  dist = rep(dist,n)
  global_monthly_switzerland <- global_monthly_switzerland %>% add_column(dist*global_monthly_swit
  ccf_switzerland = ccf(global_monthly_switzerland$meth,global_monthly_switzerland[,ncol(global_mo
  ccf_switzerland = ccf_switzerland$acf
  acf_tibble <- acf_tibble %>% add_column(ccf_switzerland, .name_repair = "unique")
}

len  = 100
acf_tibble$acf_median = rowMedians(as.matrix(acf_tibble[,c(1:len)]), na.rm =TRUE)
acf_tibble$seventyfifth_percentile = rowQuantiles(as.matrix(acf_tibble[,c(1:len)]), na.rm =TRUE,pr
acf_tibble$twentyfifth_percentile = rowQuantiles(as.matrix(acf_tibble[,c(1:len)]), na.rm =TRUE,pro
acf_tibble$lag = c(-24:24)
p2 = ggplot(acf_tibble, aes(y=acf_median,x = lag ))+ geom_line() +ylim(0, 1) + geom_ribbon(aes(ymi
```

Germany First Users

```
library(tidyr)
library(LaplacesDemon)
library(plyr)
library(matrixStats)
```

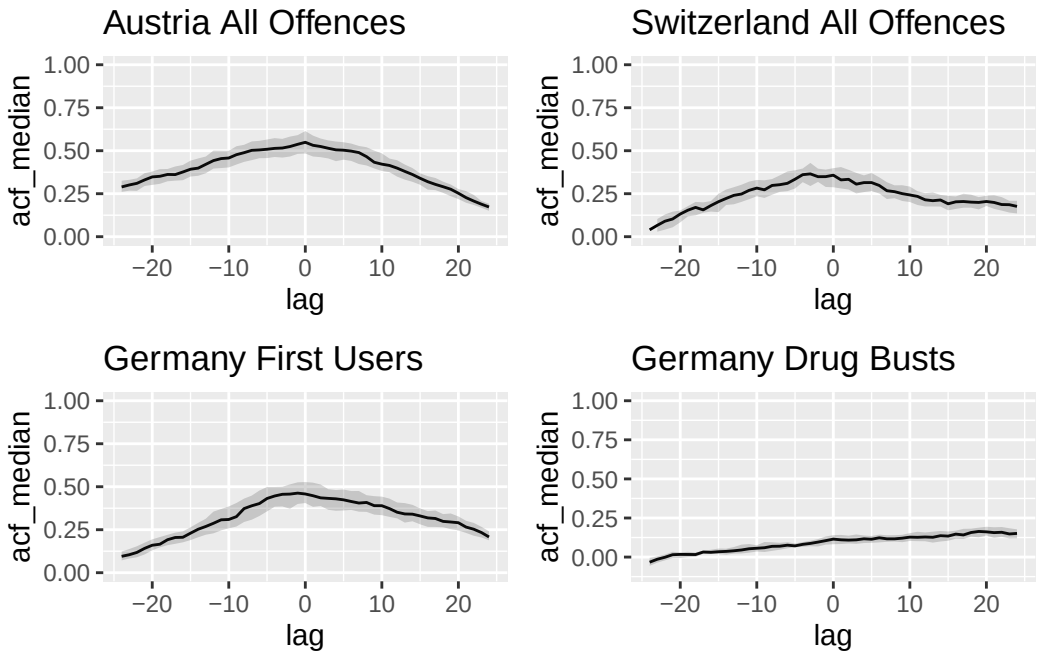
```
library(ggplot2)
dist = rdirichlet(1, c(1,1,1,1,1,1,1,1,1,1,1,1))
global_monthly_germany <-global_monthly_germany |> group_by(year) |> drop_na(firstusers_cmeth_DE)
n = length(unique(global_monthly_germany$year))

acf_tibble= data.frame(matrix(NA,
                              nrow = 49,
                              ncol = 0))
for (i in 1:100){
  dist = rdirichlet(1, c(1,1,1,1,1,1,1,1,1,1,1,1))
  dist = rep(dist,n)
  global_monthly_germany <- global_monthly_germany %>% add_column(dist*global_monthly_germany$firs
  ccf_germany = ccf(global_monthly_germany$meth,global_monthly_germany[,ncol(global_monthly_german
  ccf_germany = ccf_germany$acf
  acf_tibble <- acf_tibble %>% add_column(ccf_germany, .name_repair = "unique")
}

len  = 100
acf_tibble$acf_median = rowMedians(as.matrix(acf_tibble[,c(1:len)]), na.rm =TRUE)
acf_tibble$seventyfifth_percentile = rowQuantiles(as.matrix(acf_tibble[,c(1:len)]), na.rm =TRUE,pr
acf_tibble$twentyfifth_percentile = rowQuantiles(as.matrix(acf_tibble[,c(1:len)]), na.rm =TRUE,pro
acf_tibble$lag = c(-24:24)
p3 = ggplot(acf_tibble, aes(y=acf_median,x = lag ))+ geom_line() +ylim(0, 1) + geom_ribbon(aes(ymi
```

Germany Drug Busts

```
library(tidyr)
library(LaplacesDemon)
library(plyr)
library(matrixStats)
library(ggplot2)
dist = rdirichlet(1, c(1,1,1,1,1,1,1,1,1,1,1,1))
global_monthly_germany <- global_monthly |> filter(ccode == 'DE') |> select(c(firstusers_cmeth_DE,

n = length(unique(global_monthly_germany$year))

acf_tibble= data.frame(matrix(NA,
                              nrow = 49,
                              ncol = 0))
for (i in 1:100){
  dist = rdirichlet(1, c(1,1,1,1,1,1,1,1,1,1,1,1))
  dist = rep(dist,n)
  global_monthly_germany <- global_monthly_germany %>% add_column(dist*global_monthly_germany$drug
  ccf_germany = ccf(global_monthly_germany$meth,global_monthly_germany[,ncol(global_monthly_german
  ccf_germany = ccf_germany$acf
  acf_tibble <- acf_tibble %>% add_column(ccf_germany, .name_repair = "unique")
}

len  = 100
```

```
acf_tibble$acf_median = rowMedians(as.matrix(acf_tibble[,c(1:len)]), na.rm =TRUE)
acf_tibble$seventyfifth_percentile = rowQuantiles(as.matrix(acf_tibble[,c(1:len)]), na.rm =TRUE,pr
acf_tibble$twentyfifth_percentile = rowQuantiles(as.matrix(acf_tibble[,c(1:len)]), na.rm =TRUE,pro
acf_tibble$lag = c(-24:24)
p4 = ggplot(acf_tibble, aes(y=acf_median,x = lag ))+ geom_line() +ylim(-0.1, 1) + geom_ribbon(aes(
```

```
require(gridExtra)
grid.arrange(p1,p2,p3,p4)
```



Replicating Analysis on our 130 Samples

Importing Data

```
library(tidyverse)
df_final = read_csv("/Users/natan/Desktop/usyd/2022/sem 2/scdl3991/data/Meth.csv")
glimpse(df_final)
```

```
Rows: 3,364,132
Columns: 9
$ Region         <chr> "AT", "AT", "AT", "AT", "AT", "AT", "AT", "AT", "AT", "~
$ Term           <chr> "_m_0gt5b", "_m_0gt5b", "_m_0gt5b", "_m_0gt5b", "_m_0gt~
$ Project        <chr> "Meth", "Meth", "Meth", "Meth", "Meth", "Meth", "Meth",~
$ fileno         <dbl> 7897, 8324, 21332, 4291, 10261, 9609, 8894, 17822, 6623~
$ Date           <chr> "01JAN2004", "01JAN2004", "01JAN2004", "01JAN2004", "01~
$ ExtractionDate <chr> "26MAY2021", "27MAY2021", "29MAY2021", "31MAY2021", "01~
```

```
$ StartDate      <chr> "01JAN2004", "01JAN2004", "01JAN2004", "01JAN2004", "01~
$ EndDate        <chr> "29FEB2016", "29FEB2016", "29FEB2016", "29FEB2016", "29~
$ GT_data_point  <dbl> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0~
```

Cleaning Data

```
df_final$Date = as.Date(df_final$Date,"%d%b%Y")
df_final$ExtractionDate = as.Date(df_final$ExtractionDate,"%d%b%Y")
df_final <- df_final |> na.omit(Date) |> na.omit(GT_data_point) |> distinct()
df_final <- df_final|> select(-c('StartDate','EndDate','fileno')) |> janitor::clean_names()
df_final$meth = df_final$gt_data_point
region_code = read_csv('region_code.csv',show_col_types = FALSE)
df_final = merge(df_final,region_code,all.x=TRUE,by.x='region',by.y='Code')

df_final <- df_final |> janitor::clean_names() |> arrange(region,term, extraction_date, date) |> g
```

Checking Cross Tabulations

```
## How many date obtained for each region and term_topic
detach(package:plyr)
df_final <- df_final |> ungroup()
df_final_agg <- df_final %>% dplyr::group_by(region, term) %>% dplyr::summarise(n_distinct(extract

 ## How many gt_values for each date obtained
df_final_agg2 = df_final |> dplyr::group_by(region,term,extraction_date) |> dplyr::summarise(count

write.csv(df_final_agg,"df_final_agg.csv", row.names = FALSE)
write.csv(df_final_agg2,"df_final_agg2.csv", row.names = FALSE)
```

Splitting Meth Big Data

```
# Meth Term Data
df_final.meth <- df_final |> filter(term == 'meth')
df_meth_regional <- df_final.meth |> filter(grepl( '-', region, fixed = TRUE))
df_meth_global <- df_final.meth |> filter(!(grepl( '-', region, fixed = TRUE)))

meth_regional_split = split(df_meth_regional, df_meth_regional$extraction_date)
meth_global_split = split(df_meth_global, df_meth_global$extraction_date)


# _m_0gt5b Term Data
df_final_._m_0gt5b <- df_final |> filter(term == '_m_0gt5b')
df_m_0gt5b_regional <-df_final_._m_0gt5b|> filter(grepl( '-', region, fixed = TRUE))
df_m_0gt5b_global <- df_final_._m_0gt5b |> filter(!(grepl( '-', region, fixed = TRUE)))

m_0gt5b_global_split <- split(df_m_0gt5b_global, df_m_0gt5b_global$extraction_date)
m_0gt5b_regional_split <- split(df_m_0gt5b_regional, df_m_0gt5b_regional$extraction_date)
```

Importing PLOS Published Data

```
library(tidyverse)
setwd('/Users/natan/Desktop/usyd/2022/sem 2/scdl3991/meth paper analysis')
global_monthly = read_csv("All countries global monthly.csv")
regional_monthly = read_csv("All countries regional monthly.csv")

global_monthly <- dplyr::rename(global_monthly,  meth_paper_data = meth)
global_monthly$day = 1
regional_monthly <- dplyr::rename(regional_monthly, meth_paper_data=meth)
regional_monthly$day = 1
global_monthly$date <- as.Date(with(global_monthly,paste(year,month,day,sep="-")),"%Y-%m-%d")
regional_monthly$date <- as.Date(with(regional_monthly,paste(year,month,day,sep="-")),"%Y-%m-%d")
```

Analysis Meth Global

```
library(tidyverse)
library(ggplot2)
library(ggrepel)
library(reshape2)

files = unique(df_final$extraction_date)
results_list = list()
results_germany = rep(NA, length(meth_global_split))
results_switzerland = rep(NA, length(meth_global_split))
results_austria = rep(NA, length(meth_global_split))

i = 1

for (file in meth_global_split){
  joint_global = left_join(x = global_monthly, y =file,by = c("date" = "date", "ccode" = "region")


global_monthly_switzerland <- joint_global |> filter(ccode == 'CH') |> select(-c(firstusers_cmeth_
global_monthly_switzerland <- global_monthly_switzerland |> dplyr::group_by(year) |> mutate(meth2
global_monthly_switzerland$date<-as.Date(with(global_monthly_switzerland,paste(year,month,day,sep=


global_monthly_germany <- joint_global |> filter(ccode == 'DE') |> select(c(firstusers_cmeth_DE, n
global_monthly_germany <- global_monthly_germany |> group_by(year) |> mutate(meth2 = mean(meth))
global_monthly_germany$date<-as.Date(with(global_monthly_germany,paste(year,month,day,sep="-")),"%


global_monthly_austria <- joint_global |> filter(ccode == 'AT') |> select(c(offences_meth_AT,year,
global_monthly_austria <- global_monthly_austria |> group_by(year) |> mutate(meth2 = mean(meth))
global_monthly_austria$date<-as.Date(with(global_monthly_austria,paste(year,month,day,sep="-")),"%
list = list(global_monthly_switzerland,global_monthly_germany,global_monthly_austria)
```

```
results_austria[i] <- list(global_monthly_austria)
results_germany[i] <- list(global_monthly_germany)
results_switzerland[i] <- list(global_monthly_switzerland)
results_list <- append(results_list, list)
i =i+ 1
}

exdate = results_germany[1][[1]]$extraction_date[1]
results_germany_base = results_germany[1][[1]]
#results_germany_base[,  paste("meth",exdate, sep = "_", collapse = NULL)] = results_germany_base[
results_germany_base[,  paste("meth_avg",exdate, sep = "_", collapse = NULL)] = results_germany_ba
results_germany_base <- results_germany_base |> select(-c(meth2,meth,day,extraction_date))

exdate = results_switzerland[1][[1]]$extraction_date[1]
results_switzerland_base = results_switzerland[1][[1]]
#results_switzerland_base[,  paste("meth",exdate, sep = "_", collapse = NULL)] = results_switzerla
results_switzerland_base[,  paste("meth_avg",exdate, sep = "_", collapse = NULL)] = results_switze
results_switzerland_base <- results_switzerland_base |> select(-c(meth2,meth,gt_data_point,day,ext

exdate = results_austria[1][[1]]$extraction_date[1]
results_austria_base = results_austria[1][[1]]
#results_austria_base[,  paste("meth",exdate, sep = "_", collapse = NULL)] = results_austria_base[
results_austria_base[,  paste("meth_avg",exdate, sep = "_", collapse = NULL)] = results_austria_ba
results_austria_base <- results_austria_base |> select(-c(meth2,meth,day,extraction_date))


for (i in 2: length(results_austria)){
  exdate = results_austria[i][[1]]$extraction_date[1]
    results_austria[i][[1]] <-   results_austria[i][[1]]|> ungroup() |> select(c(date,meth,meth2))
   # results_austria[i][[1]][,  paste("meth",exdate, sep = "_", collapse = NULL)] = results_austri
    results_austria[i][[1]][,  paste("meth_avg",exdate, sep = "_", collapse = NULL)] = results_aus
    results_austria[i][[1]] <-   results_austria[i][[1]] |> select(-c(meth,meth2))
  results_austria_base = left_join(x = results_austria_base, y =results_austria[i][[1]],by = c("da
}

for (i in 2: length(results_switzerland)){
  exdate = results_switzerland[i][[1]]$extraction_date[1]
    results_switzerland[i][[1]] <-   results_switzerland[i][[1]]|> ungroup() |> select(c(date,meth
 #  results_switzerland[i][[1]][,  paste("meth",exdate, sep = "_", collapse = NULL)] = results_swi
    results_switzerland[i][[1]][,  paste("meth_avg",exdate, sep = "_", collapse = NULL)] = results
    results_switzerland[i][[1]] <-   results_switzerland[i][[1]] |> select(-c(meth,meth2))
  results_switzerland_base = left_join(x = results_switzerland_base, y =results_switzerland[i][[1]
}

for (i in 2: length(results_germany)){
  exdate = results_germany[i][[1]]$extraction_date[1]
    results_germany[i][[1]] <-   results_germany[i][[1]]|> ungroup() |> select(c(date,meth,meth2))
   # results_germany[i][[1]][,  paste("meth",exdate, sep = "_", collapse = NULL)] = results_german
    results_germany[i][[1]][,  paste("meth_avg",exdate, sep = "_", collapse = NULL)] = results_ger
```

```
    results_germany[i][[1]] <-   results_germany[i][[1]] |> select(-c(meth,meth2))
  results_germany_base = left_join(x = results_germany_base, y =results_germany[i][[1]],by = c("da
}


germany_meth_global = results_germany_base
switzerland_meth_global = results_switzerland_base
austria_meth_global = results_austria_base

switzerland_meth_global <- switzerland_meth_global |> group_by(year) |> mutate(meth_paper_avg = me
germany_meth_global <- germany_meth_global |> group_by(year) |> mutate(meth_paper_avg = mean(meth_
austria_meth_global <- austria_meth_global |> group_by(year) |> mutate(meth_paper_avg = mean(meth_
```

Switzerland Cleaning

```
switzerland_meth_global <- switzerland_meth_global|> dplyr::select(-c('ccode','month','hospitaliza
```

Switzerland Plot

```
len = length(switzerland_meth_global)-1
switzerland_meth_global$overall_avg_meth = rowMeans(as.matrix(switzerland_meth_global[,c(6:len)]),
switzerland_meth_global <- ungroup(switzerland_meth_global)
switzerland_meth_global <- switzerland_meth_global |> select(-year)
switzerland_meth_global <- melt(switzerland_meth_global, id.vars="date")


# Everything on the same plot
p1 = ggplot(switzerland_meth_global, aes(x=date,y=value, col=variable)) +
  geom_line() +
  scale_color_manual(name = "", values = c("offences_handel_gesamt" = "red","all_offences" = "dark
```

Austria Plot

```
len = length(austria_meth_global)-1
austria_meth_global$overall_avg_meth = rowMeans(as.matrix(austria_meth_global[,c(8:len)]), na.rm =
austria_meth_global <- ungroup(austria_meth_global)
austria_meth_global <- austria_meth_global |> select(-c(year, month,term,ccode,meth_paper_data))
austria_meth_global$meth_paper_avg = austria_meth_global$meth_paper_avg*4


austria_meth_global <- melt(austria_meth_global, id.vars="date")

p2 = ggplot(austria_meth_global, aes(x=date,y=value, col=variable)) +
  geom_line() +
  scale_color_manual(name = "", values = c("offences_meth_AT" = "red", "meth_paper_avg" = "orange"
```

Germany Plot

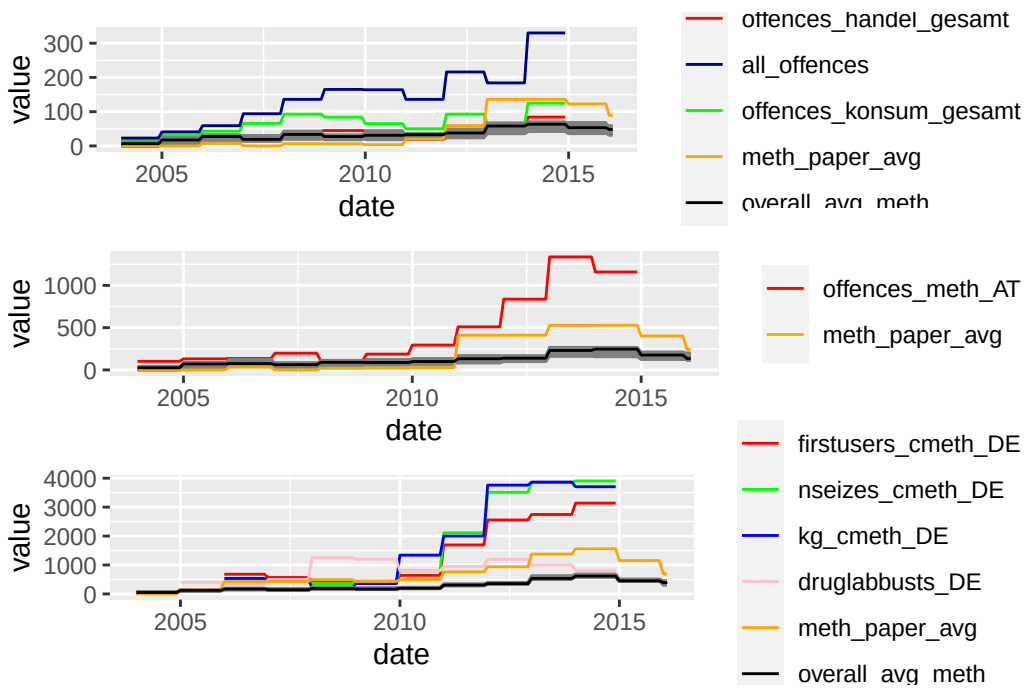
```
len = length(germany_meth_global)-1
germany_meth_global$overall_avg_meth = rowMeans(as.matrix(germany_meth_global[,c(11:len)]), na.rm
germany_meth_global <- ungroup(germany_meth_global)
germany_meth_global <- germany_meth_global |> select(-c(year, month,term,ccode,meth_paper_data))

germany_meth_global$kg_cmeth_DE = germany_meth_global$kg_cmeth_DE*50
germany_meth_global$druglabbusts_DE = germany_meth_global$druglabbusts_DE*50
germany_meth_global$meth_paper_avg = germany_meth_global$meth_paper_avg *10

germany_meth_global <- melt(germany_meth_global, id.vars="date")

p3 = ggplot(germany_meth_global, aes(x=date,y=value, col=variable)) +
  geom_line() +
  scale_color_manual(name = "", values = c("firstusers_cmeth_DE" = "red","nseizes_cmeth_DE"="green
```

```
require(gridExtra)
grid.arrange(p1,p2,p3)
```

```
Warning: Removed 42 row(s) containing missing values (geom_path).
```

```
Warning: Removed 14 row(s) containing missing values (geom_path).
```

```
Warning: Removed 140 row(s) containing missing values (geom_path).
```



Big Data Analysis __m__0gt5b Global

Cross Correlation Global Imputed Monthly

```
library(tidyverse)
setwd('/Users/natan/Desktop/usyd/2022/sem 2/scdl3991/meth paper analysis')
global_monthly = read_csv("All countries global monthly.csv")
regional_monthly = read_csv("All countries regional monthly.csv")

global_monthly <- dplyr::rename(global_monthly,  meth_paper_data = meth)
global_monthly$day = 1
regional_monthly <- dplyr::rename(regional_monthly, meth_paper_data=meth)
regional_monthly$day = 1
global_monthly$date <- as.Date(with(global_monthly,paste(year,month,day,sep="-")),"%Y-%m-%d")
regional_monthly$date <- as.Date(with(regional_monthly,paste(year,month,day,sep="-")),"%Y-%m-%d")

library(tidyverse)
library(ggplot2)
library(ggrepel)
library(reshape2)

files = unique(df_final$extraction_date)
results_list = list()
results_germany = rep(NA, length(meth_global_split))
results_switzerland = rep(NA, length(meth_global_split))
results_austria = rep(NA, length(meth_global_split))

i = 1


for (file in meth_global_split){
  joint_global = left_join(x = global_monthly, y =file,by = c("date" = "date", "ccode" = "region")


global_monthly_switzerland <- joint_global |> filter(ccode == 'CH') |> select(-c(firstusers_cmeth_
global_monthly_switzerland <- global_monthly_switzerland |> dplyr::group_by(year) |> mutate(meth2
global_monthly_switzerland$date<-as.Date(with(global_monthly_switzerland,paste(year,month,day,sep=


global_monthly_germany <- joint_global |> filter(ccode == 'DE') |> select(c(firstusers_cmeth_DE, n
global_monthly_germany <- global_monthly_germany |> group_by(year) |> mutate(meth2 = mean(meth))
global_monthly_germany$date<-as.Date(with(global_monthly_germany,paste(year,month,day,sep="-")),"%


global_monthly_austria <- joint_global |> filter(ccode == 'AT') |> select(c(offences_meth_AT,year,
global_monthly_austria <- global_monthly_austria |> group_by(year) |> mutate(meth2 = mean(meth))
global_monthly_austria$date<-as.Date(with(global_monthly_austria,paste(year,month,day,sep="-")),"%
list = list(global_monthly_switzerland,global_monthly_germany,global_monthly_austria)

results_austria[i] <- list(global_monthly_austria)
```

```
results_germany[i] <- list(global_monthly_germany)
results_switzerland[i] <- list(global_monthly_switzerland)
results_list <- append(results_list, list)
i =i+ 1
}

exdate = results_germany[1][[1]]$extraction_date[1]
results_germany_base = results_germany[1][[1]]
results_germany_base[,  paste("meth",exdate, sep = "_", collapse = NULL)] = results_germany_base[,
#results_germany_base[,  paste("meth_avg",exdate, sep = "_", collapse = NULL)] = results_germany_b
results_germany_base <- results_germany_base |> select(-c(meth2,meth,day,extraction_date))

exdate = results_switzerland[1][[1]]$extraction_date[1]
results_switzerland_base = results_switzerland[1][[1]]
results_switzerland_base[,  paste("meth",exdate, sep = "_", collapse = NULL)] = results_switzerlan
#results_switzerland_base[,  paste("meth_avg",exdate, sep = "_", collapse = NULL)] = results_switz
results_switzerland_base <- results_switzerland_base |> select(-c(meth2,meth,gt_data_point,day,ext

exdate = results_austria[1][[1]]$extraction_date[1]
results_austria_base = results_austria[1][[1]]
results_austria_base[,  paste("meth",exdate, sep = "_", collapse = NULL)] = results_austria_base[,
#results_austria_base[,  paste("meth_avg",exdate, sep = "_", collapse = NULL)] = results_austria_b
results_austria_base <- results_austria_base |> select(-c(meth2,meth,day,extraction_date))


for (i in 2: length(results_austria)){
  exdate = results_austria[i][[1]]$extraction_date[1]
    results_austria[i][[1]] <-   results_austria[i][[1]]|> ungroup() |> select(c(date,meth,meth2))
   results_austria[i][[1]][,  paste("meth",exdate, sep = "_", collapse = NULL)] = results_austria[
    #results_austria[i][[1]][,  paste("meth_avg",exdate, sep = "_", collapse = NULL)] = results_au
    results_austria[i][[1]] <-   results_austria[i][[1]] |> select(-c(meth,meth2))
  results_austria_base = left_join(x = results_austria_base, y =results_austria[i][[1]],by = c("da
}

for (i in 2: length(results_switzerland)){
  exdate = results_switzerland[i][[1]]$extraction_date[1]
    results_switzerland[i][[1]] <-   results_switzerland[i][[1]]|> ungroup() |> select(c(date,meth
   results_switzerland[i][[1]][,  paste("meth",exdate, sep = "_", collapse = NULL)] = results_swit
   # results_switzerland[i][[1]][,  paste("meth_avg",exdate, sep = "_", collapse = NULL)] = result
    results_switzerland[i][[1]] <-   results_switzerland[i][[1]] |> select(-c(meth,meth2))
  results_switzerland_base = left_join(x = results_switzerland_base, y =results_switzerland[i][[1]
}

for (i in 2: length(results_germany)){
  exdate = results_germany[i][[1]]$extraction_date[1]
    results_germany[i][[1]] <-   results_germany[i][[1]]|> ungroup() |> select(c(date,meth,meth2))
    results_germany[i][[1]][,  paste("meth",exdate, sep = "_", collapse = NULL)] = results_germany
   # results_germany[i][[1]][,  paste("meth_avg",exdate, sep = "_", collapse = NULL)] = results_ge
    results_germany[i][[1]] <-   results_germany[i][[1]] |> select(-c(meth,meth2))
```

```
  results_germany_base = left_join(x = results_germany_base, y =results_germany[i][[1]],by = c("da
}


germany_meth_global = results_germany_base
germany_meth_global_drug = results_germany_base
switzerland_meth_global = results_switzerland_base
austria_meth_global = results_austria_base
```

Austria

```
austria_meth_global <-  austria_meth_global|> ungroup() |>select(-c(month,ccode,term,date))
library(tidyr)
library(LaplacesDemon)
library(plyr)
library(matrixStats)
library(ggplot2)
dist = rdirichlet(1, c(1,1,1,1,1,1,1,1,1,1,1,1))
austria_meth_global <-austria_meth_global |> group_by(year) |> drop_na(offences_meth_AT) |> filter
n = length(unique(austria_meth_global$year))
crime_austria_imputed = data.frame(matrix(NA,
                           nrow = 132,
                           ncol = 0))
for (i in 1:100){
  dist = rdirichlet(1, c(1,1,1,1,1,1,1,1,1,1,1,1))
  dist = rep(dist,n)
  crime_austria_imputed <- crime_austria_imputed %>% add_column(dist*austria_meth_global$offences_
}


acf_tibble= data.frame(matrix(NA, nrow = 49,ncol = 0))
austria_meth_global <- austria_meth_global[,3:length(austria_meth_global)]
ccf_list = rep(NA,length(austria_meth_global))
acf_tibble_summary = data.frame(matrix(NA, nrow = 49,ncol = 0))
acf_tibble_seventyfifth= data.frame(matrix(NA, nrow = 49,ncol = 0))
acf_tibble_twentyfifth= data.frame(matrix(NA, nrow = 49,ncol = 0))


for(i in 1:length(austria_meth_global)) #for each meth extraction date
{ acf_tibble= data.frame(matrix(NA, nrow = 49,ncol = 0))
for(k in 1:100){
  ccf_austria = ccf(austria_meth_global[,i],crime_austria_imputed[,k],plot=FALSE,na.action = na.pa
  ccf_austria = ccf_austria$acf
  acf_tibble <- acf_tibble %>% add_column(ccf_austria, .name_repair = "unique")
}
  median_ccf = rowMedians(as.matrix(acf_tibble[,c(1:100)]), na.rm =TRUE)
  seventyfifth_ccf = rowQuantiles(as.matrix(acf_tibble[,c(1:100)]), na.rm =TRUE,probs = .75)
  twentyfifth_ccf = rowQuantiles(as.matrix(acf_tibble[,c(1:100)]), na.rm =TRUE,probs = .25)
  acf_tibble_summary <- acf_tibble_summary %>% add_column( median_ccf, .name_repair = "unique")
```

```
  acf_tibble_seventyfifth <- acf_tibble_seventyfifth %>% add_column( seventyfifth_ccf, .name_repai
  acf_tibble_twentyfifth <- acf_tibble_twentyfifth %>% add_column( twentyfifth_ccf, .name_repair =
}
  len  = length(acf_tibble_summary)
  acf_tibble_summary$mean_overall = rowMeans(as.matrix(acf_tibble_summary[,c(2:len)]), na.rm =TRUE
  acf_tibble_summary$lag = c(-24:24)

   len  = length(acf_tibble_seventyfifth)
  acf_tibble_seventyfifth$seventyfifth_mean_overall = rowMeans(as.matrix(acf_tibble_seventyfifth[,
  acf_tibble_seventyfifth$lag = c(-24:24)
  acf_tibble_seventyfifth <- acf_tibble_seventyfifth |> select(seventyfifth_mean_overall, lag)


    len  = length(acf_tibble_twentyfifth)
  acf_tibble_twentyfifth$twentyfifth_mean_overall = rowMeans(as.matrix(acf_tibble_twentyfifth[,c(2
  acf_tibble_twentyfifth$lag = c(-24:24)
  acf_tibble_twentyfifth <- acf_tibble_twentyfifth |> select(twentyfifth_mean_overall, lag)


  acf_tibble_summary <- merge(acf_tibble_summary, acf_tibble_twentyfifth, by = 'lag')
  acf_tibble_summary <- merge(acf_tibble_summary, acf_tibble_seventyfifth, by = 'lag' )
  acf_tibble_summary$median_ccf_top =  acf_tibble_summary$median_ccf
  acf_tibble_summary <- acf_tibble_summary |> select(-median_ccf)
  acf_tibble_summary_melted <- melt(acf_tibble_summary, id.vars="lag")



  p1 = ggplot(acf_tibble_summary_melted,aes(x=lag,y=value, col=variable))+ geom_line() +ylim(-0.1,
  scale_color_manual(name = "", values = c("median_ccf_top" = "darkblue","mean_overall"="red","sev
```

Switzerland

```
switzerland_meth_global <-  switzerland_meth_global|> ungroup()
switzerland_meth_global = switzerland_meth_global[,c(2,4,33,35:length(switzerland_meth_global))]
library(tidyr)
library(LaplacesDemon)
library(plyr)
library(matrixStats)
library(ggplot2)
dist = rdirichlet(1, c(1,1,1,1,1,1,1,1,1,1,1,1))
switzerland_meth_global <-switzerland_meth_global |> group_by(year) |> drop_na(all_offences) |> fi
n = length(unique(switzerland_meth_global$year))
crime_switzerland_imputed = data.frame(matrix(NA,
                            nrow = 132,
                            ncol = 0))
for (i in 1:100){
  dist = rdirichlet(1, c(1,1,1,1,1,1,1,1,1,1,1,1))
  dist = rep(dist,n)
  crime_switzerland_imputed <- crime_switzerland_imputed %>% add_column(dist*switzerland_meth_glob
```

```
}


acf_tibble= data.frame(matrix(NA, nrow = 49,ncol = 0))
switzerland_meth_global <- switzerland_meth_global[,c(2,4:length(switzerland_meth_global))]
ccf_list = rep(NA,length(switzerland_meth_global))
acf_tibble_summary = data.frame(matrix(NA, nrow = 49,ncol = 0))
acf_tibble_seventyfifth= data.frame(matrix(NA, nrow = 49,ncol = 0))
acf_tibble_twentyfifth= data.frame(matrix(NA, nrow = 49,ncol = 0))


for(i in 1:length(switzerland_meth_global)) #for each meth extraction date
{ acf_tibble= data.frame(matrix(NA, nrow = 49,ncol = 0))
for(k in 1:100){
  ccf_switzerland = ccf(switzerland_meth_global[,i],crime_switzerland_imputed[,k],plot=FALSE,na.ac
  ccf_switzerland = ccf_switzerland$acf
  acf_tibble <- acf_tibble %>% add_column(ccf_switzerland, .name_repair = "unique")
}
  median_ccf = rowMedians(as.matrix(acf_tibble[,c(1:100)]), na.rm =TRUE)
  seventyfifth_ccf = rowQuantiles(as.matrix(acf_tibble[,c(1:100)]), na.rm =TRUE,probs = .75)
  twentyfifth_ccf = rowQuantiles(as.matrix(acf_tibble[,c(1:100)]), na.rm =TRUE,probs = .25)
  acf_tibble_summary <- acf_tibble_summary %>% add_column( median_ccf, .name_repair = "unique")
  acf_tibble_seventyfifth <- acf_tibble_seventyfifth %>% add_column( seventyfifth_ccf, .name_repai
  acf_tibble_twentyfifth <- acf_tibble_twentyfifth %>% add_column( twentyfifth_ccf, .name_repair =
}
len  = length(acf_tibble_summary)
  acf_tibble_summary$mean_overall = rowMeans(as.matrix(acf_tibble_summary[,c(2:len)]), na.rm =TRUE
  acf_tibble_summary$lag = c(-24:24)

   len  = length(acf_tibble_seventyfifth)
  acf_tibble_seventyfifth$seventyfifth_mean_overall = rowMeans(as.matrix(acf_tibble_seventyfifth[,
  acf_tibble_seventyfifth$lag = c(-24:24)
  acf_tibble_seventyfifth <- acf_tibble_seventyfifth |> select(seventyfifth_mean_overall, lag)


    len  = length(acf_tibble_twentyfifth)
  acf_tibble_twentyfifth$twentyfifth_mean_overall = rowMeans(as.matrix(acf_tibble_twentyfifth[,c(2
  acf_tibble_twentyfifth$lag = c(-24:24)
  acf_tibble_twentyfifth <- acf_tibble_twentyfifth |> select(twentyfifth_mean_overall, lag)


  acf_tibble_summary <- merge(acf_tibble_summary, acf_tibble_twentyfifth, by = 'lag')
  acf_tibble_summary <- merge(acf_tibble_summary, acf_tibble_seventyfifth, by = 'lag' )
  acf_tibble_summary$median_ccf_top =  acf_tibble_summary$median_ccf
  acf_tibble_summary <- acf_tibble_summary |> select(-median_ccf)
  acf_tibble_summary_melted <- melt(acf_tibble_summary, id.vars="lag")


  p2 = ggplot(acf_tibble_summary_melted,aes(x=lag,y=value, col=variable))+ geom_line() +ylim(-0.1,
```

```
  scale_color_manual(name = "", values = c("median_ccf_top" = "darkblue","mean_overall"="red","sev
```

Germany First Users

```
germany_meth_global <-  germany_meth_global|> ungroup()
germany_meth_global = germany_meth_global[,c(1,5,8,11:length(germany_meth_global))]
library(tidyr)
library(LaplacesDemon)
library(plyr)
library(matrixStats)
library(ggplot2)
dist = rdirichlet(1, c(1,1,1,1,1,1,1,1,1,1,1,1))
germany_meth_global <-germany_meth_global |> group_by(year) |> drop_na(firstusers_cmeth_DE) |> fil
n = length(unique(germany_meth_global$year))
crime_germany_imputed = data.frame(matrix(NA,
                           nrow = nrow(germany_meth_global),
                           ncol = 0))
for (i in 1:100){
  dist = rdirichlet(1, c(1,1,1,1,1,1,1,1,1,1,1,1))
  dist = rep(dist,n)
  crime_germany_imputed <- crime_germany_imputed %>% add_column(dist*germany_meth_global$firstuser
}


acf_tibble= data.frame(matrix(NA, nrow = 49,ncol = 0))
germany_meth_global <- germany_meth_global[,c(3:length(germany_meth_global))]
ccf_list = rep(NA,length(germany_meth_global))
acf_tibble_summary = data.frame(matrix(NA, nrow = 49,ncol = 0))
acf_tibble_seventyfifth= data.frame(matrix(NA, nrow = 49,ncol = 0))
acf_tibble_twentyfifth= data.frame(matrix(NA, nrow = 49,ncol = 0))


for(i in 1:length(germany_meth_global)) #for each meth extraction date
{ acf_tibble= data.frame(matrix(NA, nrow = 49,ncol = 0))
for(k in 1:100){
  ccf_germany = ccf(germany_meth_global[,i],crime_germany_imputed[,k],plot=FALSE,na.action = na.pa
  ccf_germany = ccf_germany$acf
  acf_tibble <- acf_tibble %>% add_column(ccf_germany, .name_repair = "unique")
}
  median_ccf = rowMedians(as.matrix(acf_tibble[,c(1:100)]), na.rm =TRUE)
  seventyfifth_ccf = rowQuantiles(as.matrix(acf_tibble[,c(1:100)]), na.rm =TRUE,probs = .75)
  twentyfifth_ccf = rowQuantiles(as.matrix(acf_tibble[,c(1:100)]), na.rm =TRUE,probs = .25)
  acf_tibble_summary <- acf_tibble_summary %>% add_column( median_ccf, .name_repair = "unique")
  acf_tibble_seventyfifth <- acf_tibble_seventyfifth %>% add_column( seventyfifth_ccf, .name_repai
  acf_tibble_twentyfifth <- acf_tibble_twentyfifth %>% add_column( twentyfifth_ccf, .name_repair =
}
len  = length(acf_tibble_summary)
  acf_tibble_summary$mean_overall = rowMeans(as.matrix(acf_tibble_summary[,c(2:len)]), na.rm =TRUE
```

```
  acf_tibble_summary$lag = c(-24:24)

   len  = length(acf_tibble_seventyfifth)
  acf_tibble_seventyfifth$seventyfifth_mean_overall = rowMeans(as.matrix(acf_tibble_seventyfifth[,
  acf_tibble_seventyfifth$lag = c(-24:24)
  acf_tibble_seventyfifth <- acf_tibble_seventyfifth |> select(seventyfifth_mean_overall, lag)


    len  = length(acf_tibble_twentyfifth)
  acf_tibble_twentyfifth$twentyfifth_mean_overall = rowMeans(as.matrix(acf_tibble_twentyfifth[,c(2
  acf_tibble_twentyfifth$lag = c(-24:24)
  acf_tibble_twentyfifth <- acf_tibble_twentyfifth |> select(twentyfifth_mean_overall, lag)


  acf_tibble_summary <- merge(acf_tibble_summary, acf_tibble_twentyfifth, by = 'lag')
  acf_tibble_summary <- merge(acf_tibble_summary, acf_tibble_seventyfifth, by = 'lag' )
  acf_tibble_summary$median_ccf_top =  acf_tibble_summary$median_ccf
  acf_tibble_summary <- acf_tibble_summary |> select(-median_ccf)
  acf_tibble_summary_melted <- melt(acf_tibble_summary, id.vars="lag")


  p3 = ggplot(acf_tibble_summary_melted,aes(x=lag,y=value, col=variable))+ geom_line() +ylim(-0.1,
  scale_color_manual(name = "", values = c("median_ccf_top" = "darkblue","mean_overall"="red","sev
```

Germany Drug Busts

```
germany_meth_global = germany_meth_global_drug
germany_meth_global <-  germany_meth_global|> ungroup()
germany_meth_global = germany_meth_global[,c(4,5,8,11:length(germany_meth_global))]
library(tidyr)
library(LaplacesDemon)
library(plyr)
library(matrixStats)
library(ggplot2)
dist = rdirichlet(1, c(1,1,1,1,1,1,1,1,1,1,1,1))
germany_meth_global <-germany_meth_global |> group_by(year) |> drop_na(druglabbusts_DE) |> filter(
n = length(unique(germany_meth_global$year))
crime_germany_imputed = data.frame(matrix(NA,
                            nrow = nrow(germany_meth_global),
                            ncol = 0))
for (i in 1:100){
  dist = rdirichlet(1, c(1,1,1,1,1,1,1,1,1,1,1,1))
  dist = rep(dist,n)
  crime_germany_imputed <- crime_germany_imputed %>% add_column(dist*germany_meth_global$druglabbu
}


acf_tibble= data.frame(matrix(NA, nrow = 49,ncol = 0))
```

```r
germany_meth_global <- germany_meth_global[,c(3:length(germany_meth_global))]
ccf_list = rep(NA,length(germany_meth_global))
acf_tibble_summary = data.frame(matrix(NA, nrow = 49,ncol = 0))
acf_tibble_seventyfifth= data.frame(matrix(NA, nrow = 49,ncol = 0))
acf_tibble_twentyfifth= data.frame(matrix(NA, nrow = 49,ncol = 0))


for(i in 1:length(germany_meth_global)) #for each meth extraction date
{ acf_tibble= data.frame(matrix(NA, nrow = 49,ncol = 0))
for(k in 1:100){
  ccf_germany = ccf(germany_meth_global[,i],crime_germany_imputed[,k],plot=FALSE,na.action = na.pa
  ccf_germany = ccf_germany$acf
  acf_tibble <- acf_tibble %>% add_column(ccf_germany, .name_repair = "unique")
}
  median_ccf = rowMedians(as.matrix(acf_tibble[,c(1:100)]), na.rm =TRUE)
  seventyfifth_ccf = rowQuantiles(as.matrix(acf_tibble[,c(1:100)]), na.rm =TRUE,probs = .75)
  twentyfifth_ccf = rowQuantiles(as.matrix(acf_tibble[,c(1:100)]), na.rm =TRUE,probs = .25)
  acf_tibble_summary <- acf_tibble_summary %>% add_column( median_ccf, .name_repair = "unique")
  acf_tibble_seventyfifth <- acf_tibble_seventyfifth %>% add_column( seventyfifth_ccf, .name_repai
  acf_tibble_twentyfifth <- acf_tibble_twentyfifth %>% add_column( twentyfifth_ccf, .name_repair =
}
len  = length(acf_tibble_summary)
  acf_tibble_summary$mean_overall = rowMeans(as.matrix(acf_tibble_summary[,c(2:len)]), na.rm =TRUE
  acf_tibble_summary$lag = c(-24:24)

   len  = length(acf_tibble_seventyfifth)
  acf_tibble_seventyfifth$seventyfifth_mean_overall = rowMeans(as.matrix(acf_tibble_seventyfifth[,
  acf_tibble_seventyfifth$lag = c(-24:24)
  acf_tibble_seventyfifth <- acf_tibble_seventyfifth |> select(seventyfifth_mean_overall, lag)


    len  = length(acf_tibble_twentyfifth)
  acf_tibble_twentyfifth$twentyfifth_mean_overall = rowMeans(as.matrix(acf_tibble_twentyfifth[,c(2
  acf_tibble_twentyfifth$lag = c(-24:24)
  acf_tibble_twentyfifth <- acf_tibble_twentyfifth |> select(twentyfifth_mean_overall, lag)


  acf_tibble_summary <- merge(acf_tibble_summary, acf_tibble_twentyfifth, by = 'lag')
  acf_tibble_summary <- merge(acf_tibble_summary, acf_tibble_seventyfifth, by = 'lag' )
  acf_tibble_summary$median_ccf_top =  acf_tibble_summary$median_ccf
  acf_tibble_summary <- acf_tibble_summary |> select(-median_ccf)
  colnames = colnames(acf_tibble_summary[,2:129])
  acf_tibble_summary_melted <- melt(acf_tibble_summary, id.vars="lag")


  p4 = ggplot(acf_tibble_summary_melted,aes(x=lag,y=value, col=variable))+ geom_line() +ylim(-0.1,
    scale_color_manual(values=c("#CC6666"))+
  scale_color_manual(name = "", values = c(colnames = "white","median_ccf_top" = "darkblue","mean_
```

```
require(gridExtra)
grid.arrange(p1,p2,p3,p4)
```