EJAM 2.32.0

Using EJAM for Analysis in R

Source: vignettes/3_analyzing.Rmd

This article provides examples of how to use EJAM in RStudio, especially how to use more specialized functions to find specific places to analyze, such as EPA-regulated facilities defined in various ways, and how to explore the results in more detail than the web app can provide.

Running a Basic Analysis

- **`run_app()`** launches the web app locally (to run in RStudio on a single computer rather than on a server)
- **`ejamit()`** provides most results in just one function (if you already have a list of places to analyze), as shown in the Quick Start Guide

Tools for Exploring Results

For a standard analysis, the basic tools like `ejam2report()`, `ejam2excel()`, `ejam2map()`, etc. let you explore results, as shown in the Quick Start Guide.

If you want more ways to visualize and dig into results, examples are provided below in the sections on EXPLORING RESULTS and VISUALIZATION OF FINDINGS (PLOTS). For example, you can check which groups or which facilities have notable findings.

Tools for Selecting Locations to Analyze

EJAM offers a variety of ways to specify the places to be analyzed and compared. The web app helps you select locations in several ways.

If you are working in RStudio, and you already have identified the points or areas to analyze, the [ejamit()] function will accept 1) point coordinates, 2) a shapefile, or 3) a list of FIPS codes.

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places to analyze, there are several groups of functions to help with that, as shown in all the examples below. They are also shown in the EJAM package reference manual, by category.

You can specify locations for analysis in a variety of ways:

- **Near each point:** Specify points and analyze residents who are NEAR EACH POINT (PROXIMITY ANALYSIS)
  - [**Latitude and Longitude**]
  - [**Facilities by ID**] can be defined by Facility, using EPA Registry ID or by Facility, using EPA Program System ID
  - [**Facilities by Type**] can be defined by Industry (NAICS) or Facilities by Type or by Clean Air Act source category defined by by MACT Subpart (hazardous air pollutant source category)
- **Within each polygon:** Specify areas of any size and shape to analyze residents within each polygon/zone/area (based on shapefiles or Census FIPS codes)
  - **within areas or zones** on a map if you have GIS data in SHAPEFILES - Polygons (from shapefiles) could for example define redlining zones, higher risk areas based on modeling, etc.
  - **within Census units like cities or Counties** defined using FIPS CODES - Census Units such as Counties or other types of Census Units are defined by FIPS code (e.g., Counties in one State).

NEAR EACH POINT (PROXIMITY ANALYSIS)

Latitude and Longitude

You can define locations as all residents within X miles of any one or more of the specified points, and you can define those points in a few ways. One way is to upload a table of coordinates – latitude and longitude for each point, one row per site, with columns called lat and lon (or some synonyms that work). There are also more detailed functions for working with latlon coordinates.

columns, and asks you for the radius.

As explained below, you can get the latitudes and longitudes of EPA-regulated facilities if you want to specify a set of facilities by uploading their Registry ID numbers in a table, or using other identifiers. For example, there is a function `latlon_from_programid()` in the examples below.

You can also get coordinates in a few other ways, such as by NAICS (or SIC) industry names or codes, EPA program covering the set of facilities (e.g., all greenhouse gas reporters), or a Clean Air Act MACT subpart.

Facilities by ID

EPA-regulated facilities can be found in the Facility Registry Services by identification number.

by Facility, using EPA Registry ID

```
# note frs_from_regid() and latlon_from_regid() require the

frs_from_regid(c(110071293460, 110000333826))

## interactively upload file with table of REGISTRY_ID value
x <- latlon_from_regid(read_csv_or_xl()$REGISTRY_ID)

## and run through EJAM
y <- ejamit(latlon_from_regid(read_csv_or_xl()$REGISTRY_ID),
#  # still debugging Island Areas validation here!
```

by Facility, using EPA Program System ID

```
# latlon_from_programid() requires access to the frs_by_prog

if (exists("frs_by_programid")) {
  latlon_from_programid(c("XJW000012435", "00768SRTRSROAD1")
}
```

Facilities by Type

by Industry (NAICS)

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```
naics_from_any("paint and coating", children = T)
#>      code     n2     n3     n4     n5     n6
#>     <num> <char> <char> <char> <char> <char>
#> 1:  32551     32    325   3255  32551  32551 Paint and Co
#> 2: 325510     32    325   3255  32551 325510 Paint and Co
#> 3: 325510     32    325   3255  32551 325510 Paint and Co
#>                                    num_name
#>                                      <char>
#> 1:  32551 - Paint and Coating Manufacturing
#> 2: 325510 - Paint and Coating Manufacturing
#> 3: 325510 - Paint and Coating Manufacturing
## note latlon_from_naics() requires the frs_by_naics datase
# head(latlon_from_naics(325510))
# has about 1,000 facilities
#
# All sectors with this phrase in their NAICS title
#
#  x <- ejamit(frs_from_naics("paint and coating"), 1)}
```

See many more examples of Working with NAICS Codes (Industry Codes), in a section below.

by EPA Regulatory Program

```
# note latlon_from_programid() requires the frs and frs_by_p
if (exists("frs_by_programid") && exists("frs")) {

  ## Map of over 10,000 facilities in FRS identified as in t

  pts <- latlon_from_program("EGRID")[, 1:4]
  mapfast(pts)

  ## In just 1 State
  pts[, ST := state_from_latlon(lat = lat, lon = lon)$ST]
  mapfast(pts[ST == "TX", ], radius = 1)

  ## Largest lists

  epa_programs_counts <- frs_by_programid[, .N, by = "progra
  epa_programs_counts[order(-N), ][1:25, ]
}
```

by MACT Subpart (hazardous air pollutant source category)

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```
  # Search by name of category
  mact_table[grepl("ethylene", mact_table$title, ignore.case
  eto <- rbind(
    latlon_from_mactsubpart("O" ),
    latlon_from_mactsubpart("WWWWW")
  )
  #  Map the category
  mapfast(eto)


  # Browse the full list of categories
  # mact_table[ , c("N", "subpart", "title")]

  # The 10 largest categories
  tail(mact_table[order(mact_table$N), c("N", "subpart", "ti

  # Many facilities lack latitude longitude information in t
  nrow(latlon_from_mactsubpart("A", include_if_no_latlon = T
  nrow(latlon_from_mactsubpart("A", include_if_no_latlon = F

  head(latlon_from_mactsubpart("OOOO"), 2)
}
```

Working with NAICS Codes (Industry Codes)

NAICS Codes to Map or Analyze Facilities in one Industrial Sector

Overview of NAICS / industry categories, at n-digit level

```
# see NAICS categories at the top (2-digit) level

naics_categories()

# see NAICS categories at the 3-digit level

  # sorted alphabetical
naics_from_any(naics_categories(3))[order(name),.(name,code)
  # sorted by code
naics_from_any(naics_categories(3))[order(code),.(code,name)
```

Find NAICS codes, from the name of an industry

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Find industry names, from the NAICS codes

```
# get name from one code
naics_from_code(336)$name

# get the name from each code
naics_from_code(mycode)$name
```

Count facilities by NAICS code

```
mycode = c(33611, 336111, 336112)

# see counts of facilities by code (parent) and subcategorie
naics_counts[NAICS %in% mycode, ]

# see parent codes that contain each code
naicstable[code %in% mycode, ]
```

Find facilities, by name of industry

```


# See a data table of facilities in one industry
dataload_from_pins("frs")
#> Connecting to Posit Connect 2024.11.0 at
#> <https://rstudio-connect.dmap-stage.aws.epa.gov>
#> Successfully connected to Posit Connect pins board.
#>
#> frs          - is NOT in memory. Checking local disk... f
#> done.
#> frs          - was loaded from local folder, so server co
#> [1] "frs"
if (exists("frs")) {
industryword <- "pulp"

head( frs_from_naics(naics_from_any(industryword)$code)[,1:4
}
#> Connecting to Posit Connect 2024.11.0 at
#> <https://rstudio-connect.dmap-stage.aws.epa.gov>
#> Successfully connected to Posit Connect pins board.
#>
#> frs_by_naics   - is NOT in memory. Checking local disk...
```

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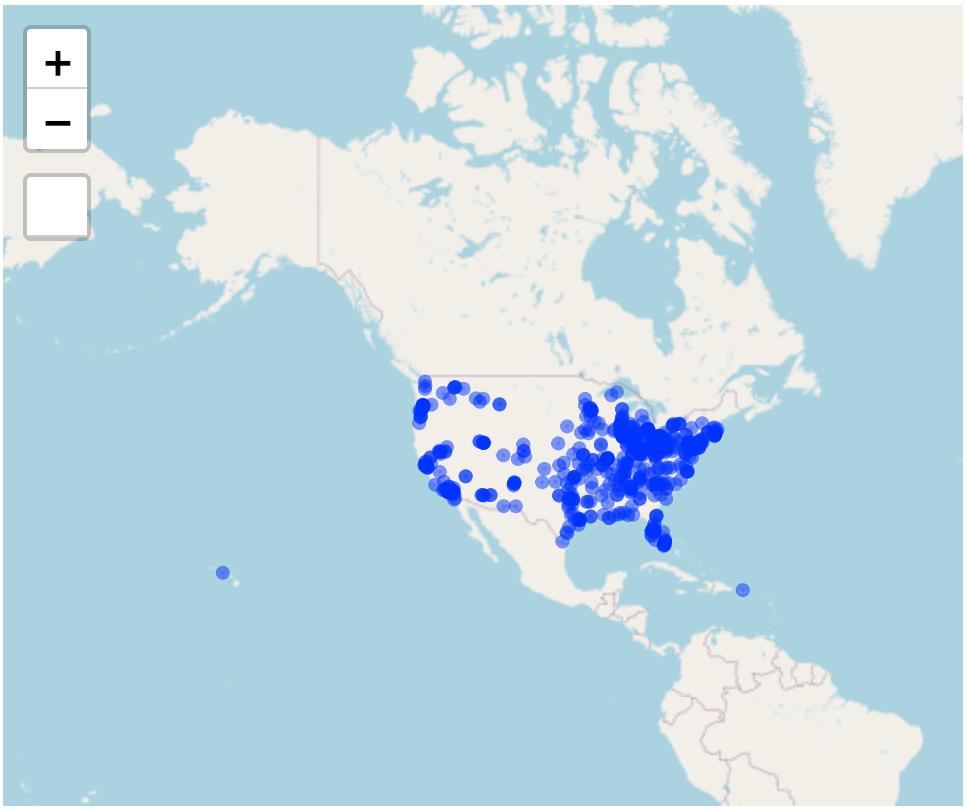
```
#>          lat       lon  REGISTRY_ID
#>        <num>     <num>       <char>
#> 1: 42.60008 -72.37838 110000308612                ERVINC
#> 2: 42.61366 -71.63378 110000308881              HOLLINGS
#> 3: 42.74216 -73.69249 110000324426       LYDALLTHERMAL/AC
#> 4: 43.55572 -76.09925 110000325443   FELIX SCHOELLER TECH
#> 5: 43.97535 -75.90653 110000325988          KNOWLTON TECH
#> 6: 44.22767 -74.99753 110000326120 NEWTON FALLS LAND RECL
```

Quick map of EPA-regulated facilities in one industrial category, which you can click on to see popup windows about sites.

```
# note frs_from_naics() requires the frs dataset, which it t
dataload_from_pins("frs")
#> Connecting to Posit Connect 2024.11.0 at
#> <https://rstudio-connect.dmap-stage.aws.epa.gov>
#> Successfully connected to Posit Connect pins board.
#>
#> frs          - was already in memory (in specified envir)
#> [1] "frs"
if (exists("frs")) {
mapfast(frs_from_naics("smelt")) # may be slow the 1st time,
}
```



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(but note that this FRS dataset lacks NAICS for most facilities!)

Table of facilities in an industry, plus links to each facility in ECHO and EJScreen

```
industryword <- "chemical manuf"
#  industryword <- "smelt"
if (exists("frs")) {
mysites <- frs_from_naics(industryword, children = FALSE)[,1

regids <- mysites$REGISTRY_ID
link1 <- url_echo_facility_webpage(regids, as_html = T)
link2 <- url_ejscreen_report(lat = mysites$lat, lon = mysite
link3 <- url_ejscreenmap(lat = mysites$lat, lon = mysites$lo
# # same:
# my_industry <- naics_from_any("chemical manuf",children =
# mysites <- frs_from_naics(my_industry$code)[,1:5]
mysites <- cbind(`ECHO report` = link1,
                 `EJScreen Report` = link2, `EJScreen Map` =
                 mysites)
caption = paste0(nrow(mysites), ' sites have NAICS matching
if (nrow(mysites) > 1500) {mysites <- mysites[1:1500, ]} # >
cat(caption,'\n')

print(
  DT::datatable(
    mysites[1:5, ],
    escape = FALSE,     rownames = FALSE,
    caption = caption,
    filter = "top"
  )
)
}
```

Map of facilities in an industry, plus popups with links to each facility in ECHO and EJScreen

```
mapfast(mysites)
```

Facilities searches using industry codes or text in industry names

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```
#>    <num> <char> <char> <char> <char> <char>
#> 1:   326     32    326    326    326    326
#>                                         name
#>                                       <char>
#> 1: Plastics and Rubber Products Manufacturing
#>                                           num_name
#>                                             <char>
#> 1: 326 - Plastics and Rubber Products Manufacturing

naics_from_any(326)
#>     code     n2     n3     n4     n5     n6
#>    <num> <char> <char> <char> <char> <char>
#> 1:   326     32    326    326    326    326
#>                                         name
#>                                       <char>
#> 1: Plastics and Rubber Products Manufacturing
#>                                           num_name
#>                                             <char>
#> 1: 326 - Plastics and Rubber Products Manufacturing

head(naics_from_any(326, children = T)[,.(code,name)])
#>      code
#>     <num>
#> 1:    326
#> 2:   3261
#> 3:  32611
#> 4: 326111
#> 5: 326112
#> 6: 326113
#>
#>
#> 1:                                  Plastics and Rubber Prc
#> 2:                                              Plastics Pr
#> 3: Plastics Packaging Materials and Unlaminated Film and
#> 4:                                        Plastics Bag and
#> 5:     Plastics Packaging Film and Sheet (including Lamir
#> 6:      Unlaminated Plastics Film and Sheet (except Packa

naics_from_any("pig")
#>      code     n2     n3     n4     n5     n6
#>     <num> <char> <char> <char> <char> <char>
#> 1:   1122     11    112   1122   1122   1122
#> 2:  11221     11    112   1122  11221  11221
#> 3: 112210     11    112   1122  11221 112210
```

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```
#>                                       <char>
#> 1:                     Hog and Pig Farming
#> 2:                     Hog and Pig Farming
#> 3:                     Hog and Pig Farming
#> 4: Synthetic Dye and Pigment Manufacturing
#> 5: Synthetic Dye and Pigment Manufacturing
#>                                     num_name
#>                                       <char>
#> 1:                      1122 - Hog and Pig Farming
#> 2:                     11221 - Hog and Pig Farming
#> 3:                    112210 - Hog and Pig Farming
#> 4:  32513 - Synthetic Dye and Pigment Manufacturing
#> 5: 325130 - Synthetic Dye and Pigment Manufacturing
naics_from_any("pig ") # space after g
#>      code     n2     n3     n4     n5     n6
#>     <num> <char> <char> <char> <char> <char>
#> 1:   1122     11    112   1122   1122   1122 Hog and Pig
#> 2:  11221     11    112   1122  11221  11221 Hog and Pig
#> 3: 112210     11    112   1122  11221 112210 Hog and Pig
#>                        num_name
#>                          <char>
#> 1:   1122 - Hog and Pig Farming
#> 2:  11221 - Hog and Pig Farming
#> 3: 112210 - Hog and Pig Farming

# a OR b,  a AND b,  etc.
a = naics_from_any("plastics")

b = naics_from_any("rubber")

library(data.table)
data.table::fintersect(a,b)[,.(name,code)] #  a AND b
#>                                                  name
#>                                                <char>  <
#> 1:          Plastics and Rubber Products Manufacturing
#> 2: Rubber and Plastics Hoses and Belting Manufacturing  3
#> 3: Rubber and Plastics Hoses and Belting Manufacturing 32

head(data.table::funion(a,b)[,.(name,code)])     #  a OR  b
#>
#>
#> 1:                                Plastics Material and
#> 2:                               Plastics and Rubber Pro
```

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```
#> 6:     Plastics Packaging Film and Sheet (including Lamir
#>      code
#>     <num>
#> 1: 325211
#> 2:    326
#> 3:   3261
#> 4:  32611
#> 5: 326111
#> 6: 326112

# naics_subcodes_from_code(funion(a,b)[,code])[,.(name,code)

head(naics_from_any(funion(a,b)[,code], children = T)[,.(nam
#>
#>
#> 1:                                Plastics and Rubber Prc
#> 2:                                            Plastics Pr
#> 3: Plastics Packaging Materials and Unlaminated Film and
#> 4:                                       Plastics Bag and
#> 5:     Plastics Packaging Film and Sheet (including Lamir
#> 6:      Unlaminated Plastics Film and Sheet (except Packa
#>      code
#>     <num>
#> 1:    326
#> 2:   3261
#> 3:  32611
#> 4: 326111
#> 5: 326112
#> 6: 326113
```

A NAICS code can have many “children” or subcategories under it

```
dataload_from_pins("frs", "frs_by_naics")
#> Connecting to Posit Connect 2024.11.0 at
#> <https://rstudio-connect.dmap-stage.aws.epa.gov>
#> Successfully connected to Posit Connect pins board.
#>
#> frs          - was already in memory (in specified envir)
#> [1] "frs"
if (exists("frs") & exists("frs_from_naics")) {

NROW(naics_from_any("chem"))
# about 20
```

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```
# a few thousand
NROW(frs_from_naics(naics_from_any("chem", children = T)$coc
# >10,000
}
#> [1] 13560
```

SHAPEFILES

Polygons in shapefiles as the places to compare

You can upload polygons in a shapefile, and use EJAM to analyze them. See the Shiny app.

See shapefile_from_any() and related functions:

```
shapefile_from_any()

shapefile_from_sitepoints()
shape_buffered_from_shapefile()
shape_buffered_from_shapefile_points()

shp1 <- shapefile_from_gdbzip(system.file("testdata/shapes/p
```

FIPS CODES

Counties as the places to compare

You can compare places defined by FIPS code, such as a group of US Counties.

Compare all Counties in a State, using EJAM indicators

```
# Get FIPS of each county in Delaware
mystate <- "Delaware"
cfips <- fips_counties_from_statename(mystate)

## You could launch a web browser tab for each of the counti
##  to see each of the County reports from EJScreen, like th
#
# sapply(url_ejscreen_report(areaid = cfips), browseURL)
```

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```
DT::datatable(x$results_bysite, escape = F)

ejam2table_tall(x)

t(x$results_bysite[ , c(
  'ejam_uniq_id', 'pop', names_d_subgroups_ratio_to_state_av

mapfastej_counties(x$results_bysite)

cnames <- fips2countyname(x$results_bysite$ejam_uniq_id)
#cnames <- c("Kent County", "New Castle County", "Sussex Cou
#cnames <- gsub(" County", "", cnames)

barplot(x$results_bysite$pctlowinc, names.arg = cnames,
        main = paste0('% Low Income by County in ', mystate)

# Another example
mystate <- "Maryland"
vname <- "% low income"
xmd <- ejamit(fips = fips_counties_from_statename(mystate))
ggblanket::gg_col(data = xmd$results_bysite,
                  y = pctlowinc,
                  x = ejam_uniq_id,
                  title = paste0(vname, ' by County in ', my
                  y_title = vname
)

mapfastej_counties(xmd$results_bysite, 'state.pctile.pctlowi
```

EXPLORING RESULTS

The most striking findings (e.g., which group is most overrepresented?)

See examples above using ejam2report() but also you can check some key findings like this:

```
x <- testoutput_ejamit_1000pts_1miles
out <- x$results_bysite
out <- setDF(copy(out))
ratio_benchmarks <- c(1.01, 1.50, 2, 3, 5, 10)
ratiodata <- out[, names_d_ratio_to_state_avg]
```

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```
tail(findings$text[findings$text != ""], 1) # the most extre
#> [1] "At at least 3% of these sites, 1 of the indicators i
```

The key facilities (e.g., which has the max of – or has multiple elevated – EJ indexes?)

```
out2 <- ejamit(
  sitepoints =  testpoints_100,
  radius = 3.1
)
x <- out2$results_summarized$cols
x <- x[order(x[,1], decreasing = T), ]
head(x, 3)
cat("\n")
x <- x[order(x[,2], decreasing = T), ]
head(x, 3)
```

More summary findings

```
dimnames(findings)
#> NULL
findings$text[2]
#> [1] "At at least 93% of these sites, 1 of the indicators
head(findings$stats[ , , 1], 15)
#>       cut
#> count 1.01   2   5  10
#>     0   67 709 974 997
#>     1  189 165  26   3
#>     2  171  52   0   0
#>     3  117  36   0   0
#>     4   92  19   0   0
#>     5   91  11   0   0
#>     6   73   5   0   0
#>     7   90   3   0   0
#>     8  106   0   0   0
#>     9    4   0   0   0
head(findings$stats[ , 1, ], 21)
#>       stat
#> count count  cum pct cum_pct
#>     0    67 1000   7     100
#>     1   189  933  19      93
#>     2   171  744  17      74
#>     3   117  573  12      57
```

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```
#>     7    90  200   9      20
#>     8   106  110  11      11
#>     9     4    4   0       0
x = findings$stats[ , 1, ]
x[x[, "cum_pct"] >= 50 & x[, "cum_pct"] <= 80, ]
#>      stat
#> count count cum pct cum_pct
#>     2   171 744  17      74
#>     3   117 573  12      57
findings$stats[ 1, , ]
#>       stat
#> cut    count  cum pct cum_pct
#>   1.01    67 1000   7     100
#>   2      709 1000  71     100
#>   5      974 1000  97     100
#>   10     997 1000 100     100
```

Site by site detailed results in datatable format in RStudio viewer:

```
out2 <- testoutput_ejamit_100pts_1miles
DT::datatable(out2$results_bysite[1:5,   ], escape = FALSE,

# To see all 1,000 sites in table:
#DT::datatable(out2$results_bysite[1:1000, ], escape = FALSE
```

Overall results for a few key indicators, as raw output in console:

```
out2 <- testoutput_ejamit_100pts_1miles

names(out2)
#> [1] "results_overall"                    "results_bysite
#> [3] "results_bybg_people"                "longnames"
#> [5] "count_of_blocks_near_multiple_sites" "results_summar
#> [7] "formatted"                          "sitetype"
cbind(overall = as.list( out2$results_overall[ , ..names_d])
#>                 overall
#> Demog.Index     1.640289
#> Demog.Index.Supp 1.631243
#> pctlowinc       0.3199508
#> pctlingiso      0.07993421
```

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```
#> pctover64         0.1447244
#> pctmin            0.5595154
cbind(overall = as.list( out2$results_overall[ , ..names_d_s
#>                  overall
#> pcthisp          0.2788923
#> pctnhba          0.1472757
#> pctnhaa          0.0873758
#> pctnhaiana       0.002454578
#> pctnhnhpia       0.001571147
#> pctnhotheralone  0.005819709
#> pctnhmulti       0.03612613
#> pctnhwa          0.4404846
```

Overall results for the very long list of all indicators, as raw output in console:

```
out2 <- testoutput_ejamit_100pts_1miles

head(
  ejam2table_tall(out2)
  , 20)
# head(
#   cbind(as.list(out2$results_overall))
#   , 12)
```

Just one site, all the indicators

```
head(
  ejam2table_tall(out2, sitenumber = 1)
  , 20)
```

See indicators aggregated over all people across all sites

```
## view output of batch run aggregation ####
out <- testoutput_ejamit_1000pts_1miles
head(cbind(overall = as.list( out$results_overall)))
#>                  overall
#> EJScreen Report  NA
#> EJScreen Map     NA
#> ECHO report      NA
#> ejam_uniq_id     NA
#> valid            TRUE
#> invalid_msg      ""
```

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```
#>                  overall
#> pm               9.4237
#> o3               65.9796
#> no2              11.08754
#> dpm              0.3321597
#> rsei             4227.326
#> traffic.score    4083324
#> pctpre1960       0.4255891
#> proximity.npl    1.036089
#> proximity.rmp    0.7589651
#> proximity.tsdf   10.38343
#> ust              8.573221
#> proximity.npdes 50125.2
#> drinking         NA
cbind(overall = as.list( out$results_overall[ , ..names_d]))
#>                   overall
#> Demog.Index      1.718163
#> Demog.Index.Supp 1.765287
#> pctlowinc        0.3356696
#> pctlingiso       0.09735858
#> pctunemployed    0.06679282
#> pctlths          0.1511022
#> pctunder5        0.05880198
#> pctover64        0.1396016
#> pctmin           0.5856438
cbind(overall = as.list( out$results_overall[ , ..names_d_su
#>                  overall
#> pcthisp          0.3341704
#> pctnhba          0.1156517
#> pctnhaa          0.09142377
#> pctnhaiana       0.002953629
#> pctnhnhpia       0.001746431
#> pctnhotheralone 0.00578322
#> pctnhmulti       0.03391459
#> pctnhwa          0.4143562
cbind(overall = as.list( out$results_overall[ , ..names_e_pc
#>                       overall
#> pctile.pm             81
#> pctile.o3             74
#> pctile.no2            82
#> pctile.dpm            87
#> pctile.rsei           84
#> pctile.traffic.score  88
```

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```
#> pctile.proximity.tsdf  91
#> pctile.ust             87
#> pctile.proximity.npdes 95
#> pctile.drinking        NA
cbind(overall = as.list( out$results_overall[ , ..names_d_pc
#>                          overall
#> pctile.Demog.Index       70
#> pctile.Demog.Index.Supp  63
#> pctile.pctlowinc         61
#> pctile.pctlingiso        85
#> pctile.pctunemployed     69
#> pctile.pctlths           73
#> pctile.pctunder5         61
#> pctile.pctover64         41
#> pctile.pctmin            71
# cbind(overall = as.list( out$results_overall[ , ..names_ej
```

VISUALIZATION OF FINDINGS (PLOTS)

Indicators

Barplot showing which indicator is most elevated overall

```
out <- testoutput_ejamit_1000pts_1miles

ejam2barplot(out,
  varnames = c(names_d_ratio_to_state_avg, names_d_subgroups
  main = "Demographics at Selected Sites Compared to State A
```

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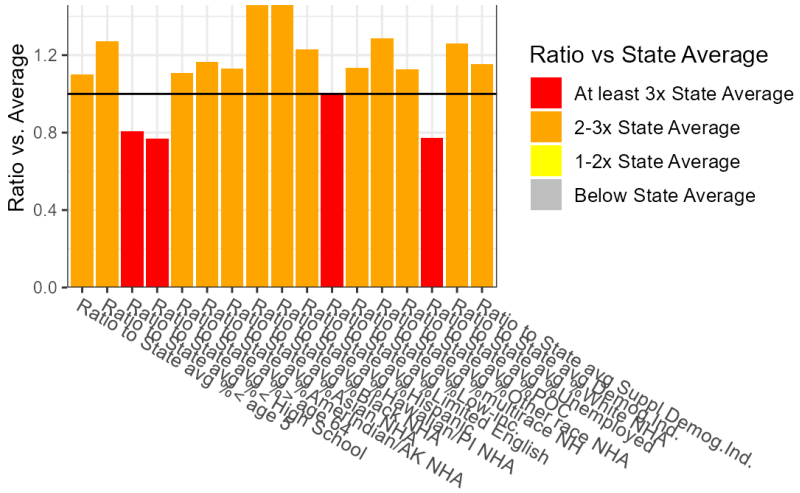
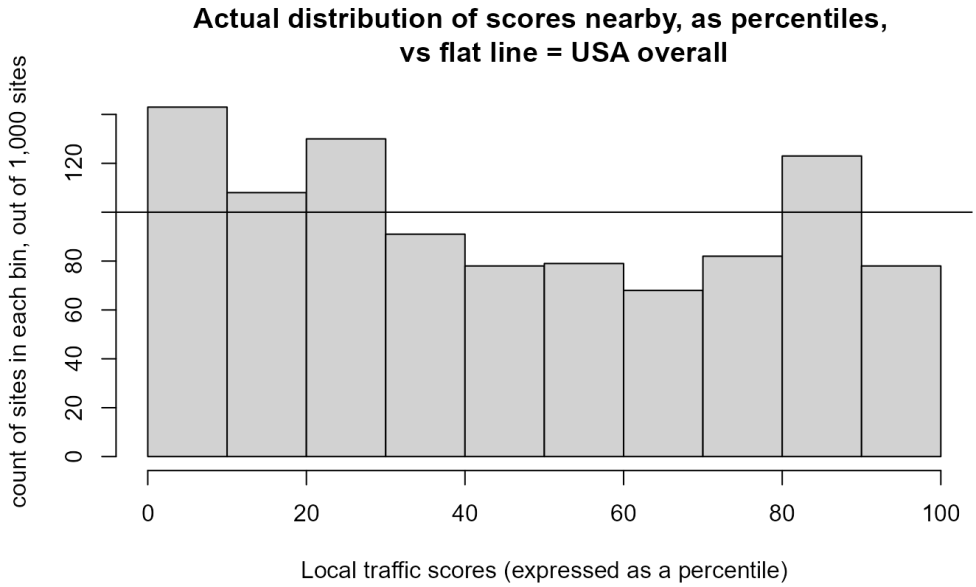


Histogram of indicators distribution over all people across all sites

```
hist(out$results_bysite$pctile.traffic.score, 10, xlab = "Lo
     ylab = "count of sites in each bin, out of 1,000 sites'
     main = "Actual distribution of scores nearby, as percer
     vs flat line = USA overall")
abline(h = nrow(out$results_bysite)/10)
```



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Running a Basic Analysis

Tools for Exploring Results

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SHAPEFILES

FIPS CODES

EXPLORING RESULTS

VISUALIZATION OF FINDINGS (PLOTS)

US EPA 2025 EJAM Version 2.32.0