# Advanced Data Analysis in R

## Survey Analsis in R

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# Survey Analysis in R

# What makes survey analysis different?

Survey analysis is *design based*

Often we talk about *probability or random samples*

These concepts make inferences really nice

# Properties of Design Based Surveys

A quick refresher[1]

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[1] Lumley (2010)

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# Introducing the `survey` package

# A little about `survey`

Thomas Lumley developed the `survey` package

Initially a port of STATA's `svy` functions following a similar syntax

Can perform typical types of design based analysis

- Simple Random
- Stratified
- Clusters
- Multi-stage
- Repeated Measures

# A little about `survey`

Perform post-survey corrections

- post-stratification
- raking (iterative proportional fitting)
- calibration

And more. . . !

# Diving into the software. . .

# Describing your model

The primary argument in survey is the svydesign function

```
library(survey)

svydesign(ids = to specify clusters (~1 otherwise),
          probs = Sampling Probabilities if available,
          strata = Strata membership if available,
          fpc = Finite Population Values,
          data = Your Data Frame,
          nest = T/F if there is nesting within your st
          weights = Sampling Weights if available,
          pps = Probability Proportional to Size)
```

# Quick Note On `survey`

Many of the functions in `survey` utilise R "formula notation"

Indicates the tilde "~" must be used (e.g. `~cluster`)

# But Let's Try An Example

Let's try an example with the `api` dataset that is part of the `survey` package

This data set represents California Academic Performance Index

```
library(survey)
library(dplyr)
data(api)
```

# Let's Inspect the Data

```
head(apisrs)
##                      cds stype              name
## 1039 15739081534155     H  McFarland High
## 1124 19642126066716     E Stowers (Cecil
## 2868 30664493030640     H Brea-Olinda Hig
## 1273 19644516012744     E Alameda Element
## 4926 40688096043293     E Sunnyside Eleme
## 2463 19734456014278     E Los Molinos Ele
##                                    sname snum
## 1039                     McFarland High 1039
## 1124 Stowers (Cecil B.) Elementary 1124
## 2868                 Brea-Olinda High 2868
## 1273               Alameda Elementary 1273
## 4926             Sunnyside Elementary 4926
```

# Specifying the Survey Object (SRS)

This is a simple random sample with finite population correct (since we know the population)

```
(svy_api_srs <- svydesign(ids = ~1,
                          fpc = ~fpc,
                          data = apisrs))
## Independent Sampling design
## svydesign(ids = ~1, fpc = ~fpc, data = apisrs)
```

# Trying With A Different Survey Design (Stratified)

In this case we have a stratified random sample (different school types)

```
(svy_api_strat <- svydesign(ids= ~1,
                            strata = ~stype,
                            fpc = ~fpc,
                            data = apistrat))
## Stratified Independent Sampling design
## svydesign(ids = ~1, strata = ~stype, fpc = ~fpc, d
```

# Trying With A Different Survey Design (Cluster)

Two stage cluster sampling 40 school disticts then five schools within each district

- Stage 1 district cluster with population `fpc1`
- Stage 2 district cluster with population `fpc2`

```
(svy_api_cluster <- svydesign(ids= ~dnum+snum,
                              fpc = ~fpc1+fpc2,
                              data = apiclus2))
## 2 - level Cluster Sampling design
## With (40, 126) clusters.
## svydesign(ids = ~dnum + snum, fpc = ~fpc1 + fpc2,
```

# Analysis with svy objects

# Correct Estimates

survey applies correct calculations given the survey design

```
svymean(~api00, svy_api_cluster)
##             mean     SE
## api00 670.81 30.099
```

vs

```
cbind(mean(apiclus2[["api00"]]),
      sd(apiclus2[["api00"]]))
##             [,1]     [,2]
## [1,] 703.8095 134.1507
```

# Survey Functions

Functions in the `survey` package begin with the `svy` prefix

Utilise the formula notation

```
svyquantile(x = ~api99+api00,
            svy_api_srs,
            quantile= c(0.25,.75))
##         0.25 0.75
## api99    513  738
## api00    544  752
```

# Calculating Contrasts

You can add contrasts with `svycontrast`

Say I wanted to look at the ratio of my high school score to my elementary school score

```
# Mean
mean_score <- svyby( ~api99, ~stype, svymean,
                     design = svy_api_cluster)
# Contrast ratio use `quote`
svycontrast(mean_score, quote(H/E))
##             nlcon     SE
## contrast 0.90614 0.0507
```

# Adding Contrasts to the data

Use the update function to add new calculated fields to your survey design object

```
(svy_api_cluster <- update(svy_api_cluster,
                           score_imp = api00/api99))
## 2 - level Cluster Sampling design
## With (40, 126) clusters.
## update(svy_api_cluster, score_imp = api00/api99)
```

```
svyby(~score_imp, ~stype, svymean,
        design = svy_api_cluster)
##   stype score_imp          se
## E     E  1.057525 0.006591223
## H     H  1.005193 0.003781072
## M     M  1.017354 0.012393586
```

# Performing Regressions

# Post-survey corrections

# References

Lumley, Thomas. 2010. *Complex Surveys: A Guide to Analysis Using R*. John Wiley & Sons.