Regression case study

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In this session

Shorter lecture section, presenting a worked example

Longer exercise section, for you to do one

NHANES data example

Data on blood pressure and diet from the US NHANES health survey.

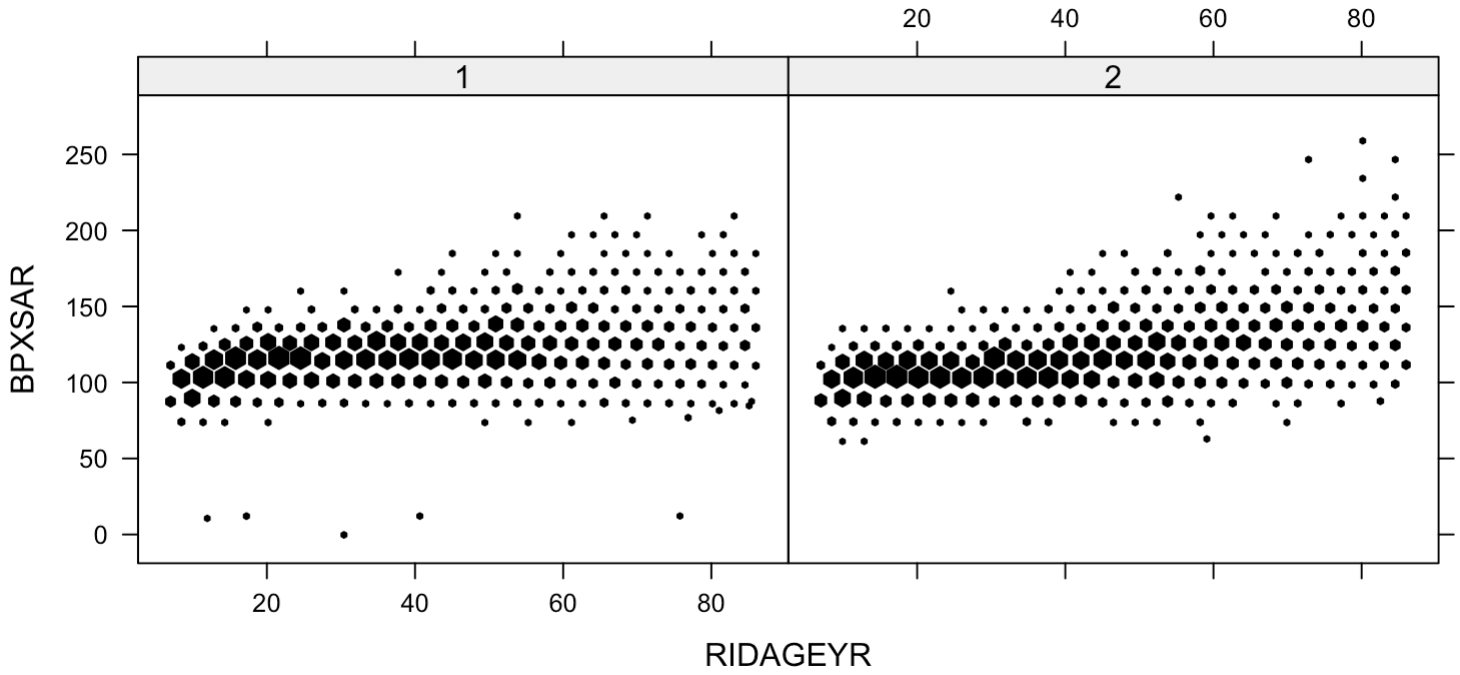
Complex four-stage survey, but public-use data approximates by two-stage design.

Already done: select blood pressure, BMI, age, gender, race/ethnicity, dietary sodium, potassium from various NHANES files for two two-year waves.

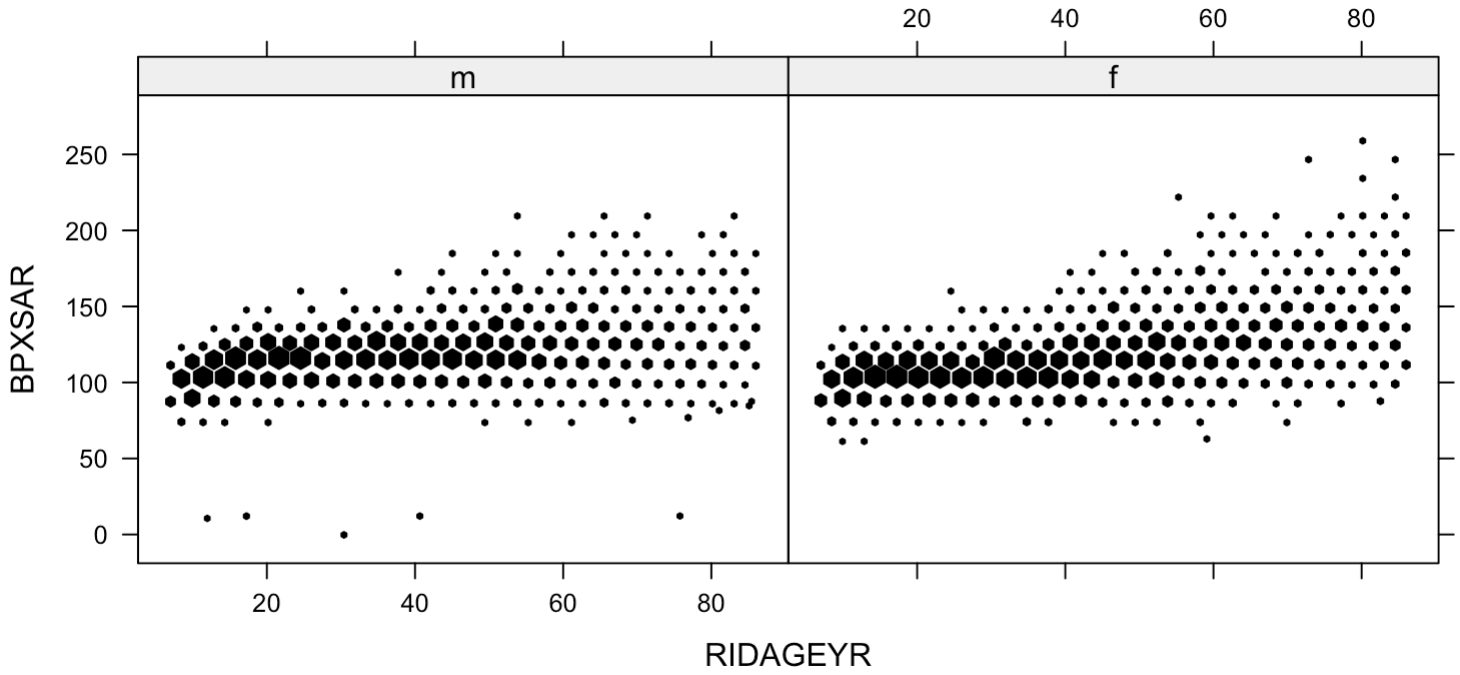
Survey definition

```
nhanes$fouryearwt <- nhanes$WTDRD1/2
nhanesdes <- svydesign(id=~SDMVPSU, strata=~SDMVSTRA,
      weights=~fouryearwt, nest=TRUE
      data=subset(nhanes, !is.na(WTDRD1)))
nhanesdes <- update(nhanesdes, sodium=DR1TSODI/1000
      potassium=DR1TPOTA/1000)
nhanesdes <- update(nhanesdes, namol = sodium/23,
      kmol= potassium/23)
nhanesdes <- update(nhanesdes, htn = (BPXSAR>140) | (BPXDAR>90))
```

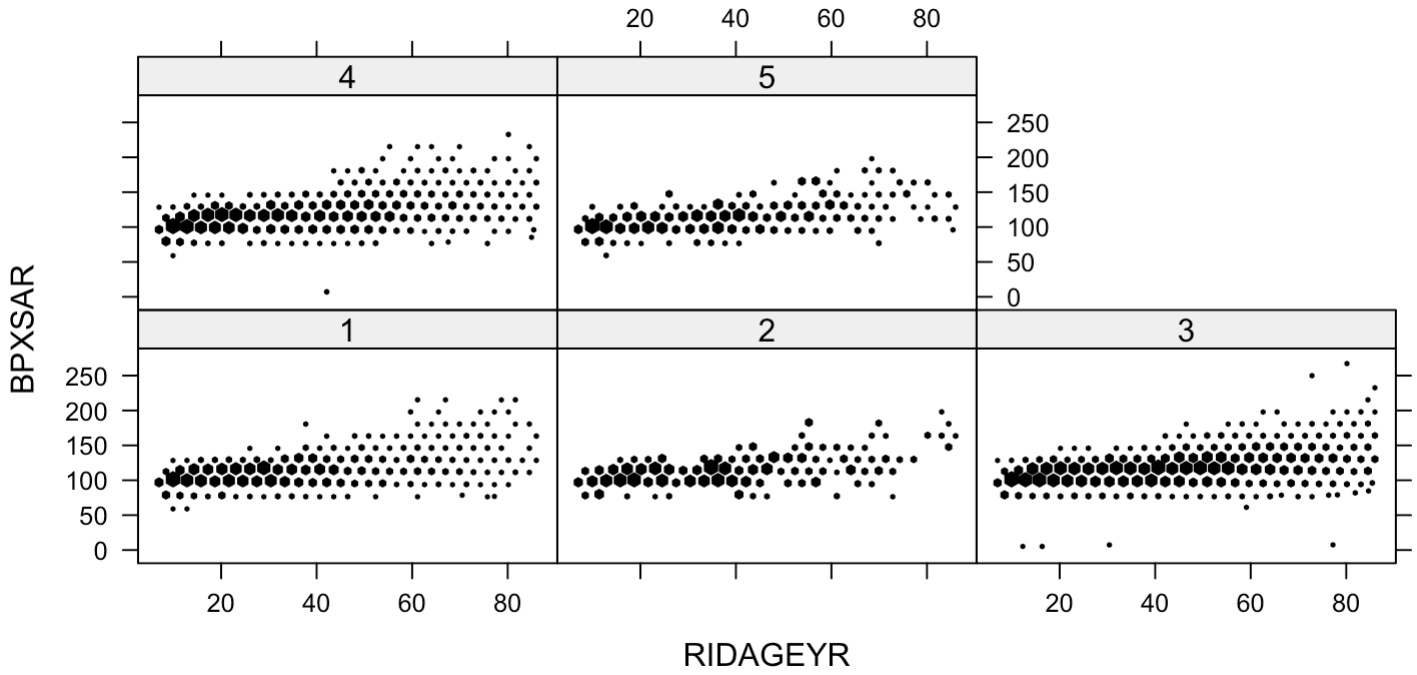
```
svycoplot(BPXSAR~RIDAGEYR|factor(RIAGENDR),design=nhanesdes,xbins=30)
```



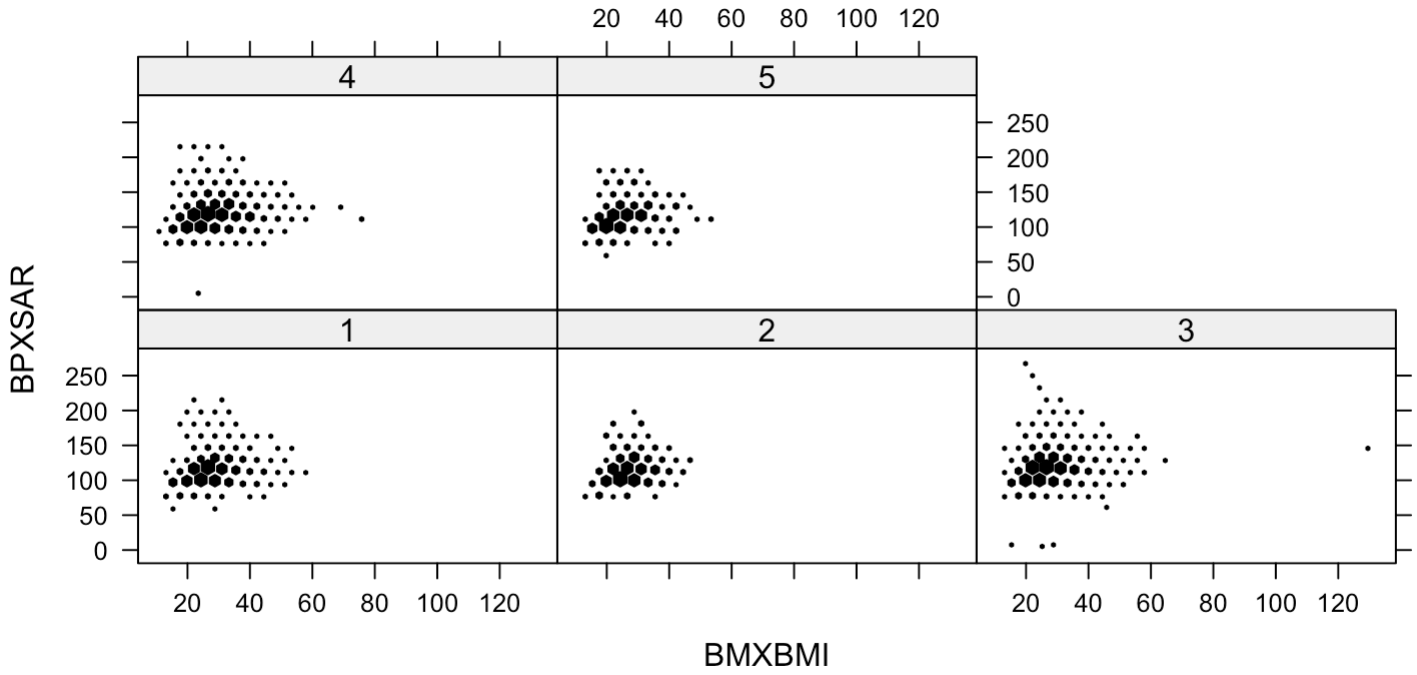
```
svycoplot(BPXSAR~RIDAGEYR|factor(RIAGENDR,labels=c("m","f")),design=nhanesdes,xbins=30)
```



```
svycoplot(BPXSAR~RIDAGEYR|factor(RIDRETH1),design=nhanesdes,xbins=30)
```



```
svycoplot(BPXSAR~BMXBMI|factor(RIDRETH1),design=nhanesdes,xbins=30)
```



Linear regression example

Unadjusted model

```
coef(summary(model<-svyglm(BPXSAR~sodium+potassium,
              design=nhanesdes)))
```

```
##             Estimate Std. Error t value  Pr(>|t|)
## (Intercept) 120.3899     0.7105 169.436 1.039e-43
## sodium       -0.6907     0.1658  -4.166 2.685e-04
## potassium     0.7750     0.2655   2.919 6.853e-03
```

Age/sex adjusted

```
coef(summary(model<-svyglm(BPXSAR~RIAGENDR+RIDAGEYR+sodium+potassium,
              design=nhanesdes)))
```

```
##              Estimate Std. Error t value  Pr(>|t|)
## (Intercept) 105.8284    1.22299  86.532 1.583e-33
## RIAGENDR     -3.3004    0.37878  -8.713 3.437e-09
## RIDAGEYR      0.4976    0.01149  43.298 9.159e-26
## sodium        0.5943    0.16008   3.712 9.855e-04
## potassium    -1.0884    0.18169  -5.990 2.524e-06
```

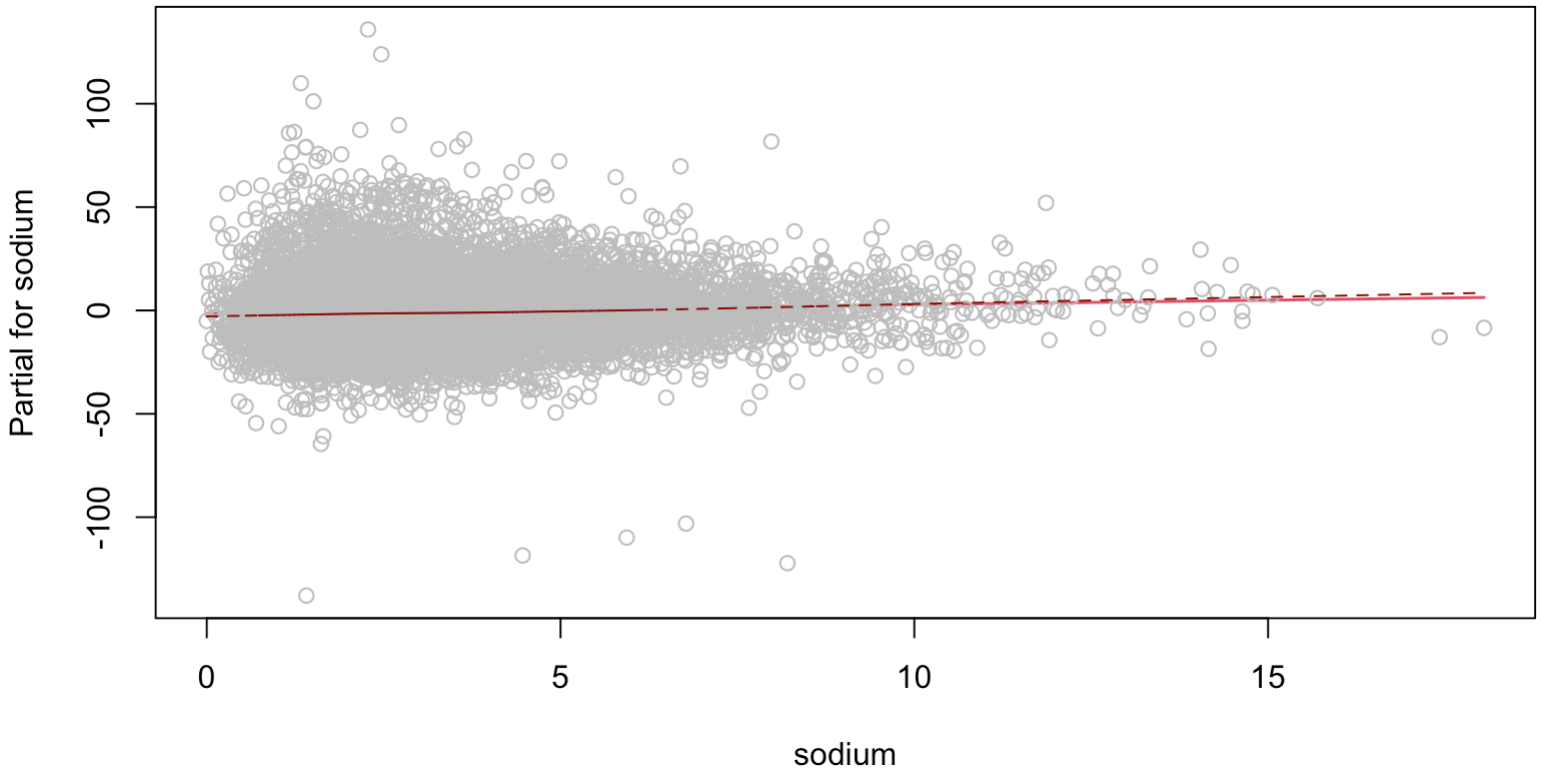
More adjusted

```
coef(summary(model<-svyglm(BPXSAR~RIAGENDR+RIDAGEYR+factor(RIDRETH1)
                  +BMXBMI+sodium+potassium,
               design=nhanesdes)))
```

```
##                   Estimate Std. Error t value  Pr(>|t|)
## (Intercept)        97.0462    1.38921 69.8573 2.354e-26
## RIAGENDR           -3.3705    0.38507 -8.7529 1.891e-08
## RIDAGEYR            0.4651    0.01145 40.6221 1.905e-21
## factor(RIDRETH1)2   0.2377    1.35465  0.1755 8.624e-01
## factor(RIDRETH1)3  -0.5100    0.62820 -0.8119 4.260e-01
## factor(RIDRETH1)4   3.0297    0.64396  4.7049 1.207e-04
## factor(RIDRETH1)5   1.2947    0.88675  1.4600 1.591e-01
## BMXBMI              0.3710    0.03806  9.7478 3.024e-09
## sodium              0.4288    0.16190  2.6486 1.502e-02
## potassium          -0.8499    0.17133 -4.9606 6.578e-05
```

Relationship is very weak: nonlinear?

```
termplot(model,terms=5,partial=TRUE,smooth=panel.smooth)
```



Perhaps age is nonlinear?

```
library(splines)
model2<-svyglm(BPXSAR~RIAGENDR*ns(RIDAGEYR,4)+factor(RIDRETH1)
                    +BMXBMI+sodium+potassium,
               design=nhanesdes)
coef(summary(model2))[c("sodium","potassium"),]
```

```
##           Estimate Std. Error t value  Pr(>|t|)
## sodium      0.3082     0.1567   1.966 0.0694138
## potassium  -0.7229     0.1636  -4.418 0.0005839
```

No real change. Weak association may be true or due to measurement error.

Some tests

```
AIC(model,model2)
```

```
##      eff.p    AIC deltabar
## [1,] 21.24 114804    2.124
## [2,] 34.36 114248    2.021
```

```
regTermTest(model2, ~sodium+potassium)
```

```
## Wald test for sodium potassium
##  in svyglm(formula = BPXSAR ~ RIAGENDR * ns(RIDAGEYR, 4) + factor(RIDRETH1) +
##     BMXBMI + sodium + potassium, design = nhanesdes)
## F =  9.77  on  2  and  14  df: p= 0.0022
```

```
regTermTest(model2, ~factor(RIDRETH1),method="Wald")
```

```
## Wald test for factor(RIDRETH1)
##  in svyglm(formula = BPXSAR ~ RIAGENDR * ns(RIDAGEYR, 4) + factor(RIDRETH1) +
##     BMXBMI + sodium + potassium, design = nhanesdes)
## F =  14.84  on  4  and  14  df: p= 0.000061
```

```
regTermTest(model2, ~factor(RIDRETH1),method="LRT")
```

```
## Working (Rao-Scott+F) LRT for factor(RIDRETH1)
##  in svyglm(formula = BPXSAR ~ RIAGENDR * ns(RIDAGEYR, 4) + factor(RIDRETH1) +
##     BMXBMI + sodium + potassium, design = nhanesdes)
## Working 2logLR =  40.9 p= 0.00067
## (scale factors:  1.5 1.3 0.75 0.46 );  denominator df= 14
```

Now, hypertension

```
model_htn<-svyglm(htn~RIAGENDR*ns(RIDAGEYR,4)+factor(RIDRETH1)
                  +BMXBMI+sodium+potassium,
                design=nhanesdes, family=quasibinomial())
```

```
coef(summary(model_htn))
```

```
##                                Estimate Std. Error t value Pr(>|t|)
## (Intercept)                  -13.80003    3.44255 -4.0087 0.001294
## RIAGENDR                       3.82846    1.82753  2.0949 0.054850
## ns(RIDAGEYR, 4)1              11.78098    3.38031  3.4852 0.003641
## ns(RIDAGEYR, 4)2               6.46797    2.40486  2.6895 0.017614
## ns(RIDAGEYR, 4)3              24.46024    6.62715  3.6909 0.002420
## ns(RIDAGEYR, 4)4               3.60093    1.76480  2.0404 0.060636
## factor(RIDRETH1)2              0.10221    0.32679  0.3128 0.759073
## factor(RIDRETH1)3             -0.07610    0.14923 -0.5099 0.618050
## factor(RIDRETH1)4              0.42435    0.15785  2.6883 0.017657
## factor(RIDRETH1)5              0.47596    0.20787  2.2896 0.038090
## BMXBMI                         0.03347    0.00829  4.0372 0.001223
## sodium                         0.03142    0.03947  0.7961 0.439292
## potassium                     -0.05121    0.04918 -1.0413 0.315408
## RIAGENDR:ns(RIDAGEYR, 4)1     -4.81717    1.85668 -2.5945 0.021203
## RIAGENDR:ns(RIDAGEYR, 4)2     -0.54762    1.35303 -0.4047 0.691789
## RIAGENDR:ns(RIDAGEYR, 4)3    -11.12228    3.53841 -3.1433 0.007187
## RIAGENDR:ns(RIDAGEYR, 4)4     1.87404    1.16184  1.6130 0.129053
```