Accountants-Auditors-IPUMS

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Accountants and auditors from IPUMS

I created an account with the Integrated Public Use Microdata Series (IPUMS) data library at the University of Minnesota and selected and requested historical data on the number of accountants and auditors in the US labor force dating back to 1850 “Selecting harmonized variables” > Person > Work.

From here, I first selected “OCC1950 = Occupation 1950 basis” and got something useful doing that.

Later I redid the exercise adding OCC = Occupaton“. Then”Data cart: Your data extract" said, “2 variable, 32 samples”. Then clicking “View Cart” listed 9 variables, being “YEAR”, “DATANUM”, “SERIAL”, “HHWT”, “GQ”, “PERNUM”, “PERWT”, “OCC”, and “OCC1950”. Then I clicked, “Create data extract”. This allowed me to further “select data quality flags” for GQ, OCC, and OCC1950. The first time I did this, I ignored the data quality flags. The second time, I requested them. However, with both the additional “OCC” and the data quality flags, the data set was bigger than I could read into my computer. So I split that extract into two for seq(1850, 2000, 10) and for 2001:2016. When I read the 2001:2016 extract, I found that I could not understand “OCC” nor the data quality flags. I decided that the answer I already had was probably good enough, and it wasn’t clear if I could learn enough to justify the work of further study of “OCC” and the data quality flags.

In any event, after each data selection, I was given an “estimated size” for the extract (5340 MB for one trial). I entered something to “Describe your extract”. Then I clicked, “Submit extract”. The IPUMS web site responded saying, “Your extract request has been submited. You will be notfied by email at (the email address I had given them) when it has been created.” Under “Data”, it said, “Processing…”. When it completed, the “Processing…” changed to “Download .DAT”.

After while (47 minutes for one extract on 2018-09-03) I got an email saying my extract was ready for download.

I clicked “Download .DAT” under “Data” and “R” under “Command files”. The “R” code started with “ddi <- read_ipums_ddi(”usa_00002.xml“)”, but I downloaded a *.DAT file, and not a* .xml file.

I was confused. To get past this problem, I read the fine manual (RTFM). Specifically, from “help(pac=ipumsr)” I found that the ipumsr package included six vignettes. One of those is titled “Introduction to ipumsr - IPUMS Data in R”. From that, I learned that I needed to right-click (ctrl-click on a Mac) on “DDI” under “Codebook” and then select “Save link as…”. Moreover, I should NOT do this in Safari. Google Chrome worked for me for this on 2018-09-01 and Firefox worked when I repeated it with a slightly different extract on 2018-09-03.

Following this process, I downloaded “usa_00002.dat.gz”, which unzipped into “use_00002.dat” consuming 5.6 GB of data plus “usa_00002.xml” being a codebook file of size 73 KB.

Then I followed the instructions in the “Command File” for R, and got, “Error: Error in read_tokens_(data,

tokenizer, col_specs, col_names, locale_, : Evaluation error: vector memory exhausted (limit reached?).”

This same process had worked earlier with my first extraction, “usa_00001.". *I decided to ignore OCC and the data quality flags, as mentioned above. The rest of this vignette describes what I did with "usa_00001.*”.

```
# Change readAndCompute to TRUE to actually run this.
# It's set to FALSE, because "usa_00001.dat" is too big to keep
# and it takes too long to read and process with routing testing.
readAndCompute <- TRUE
# "usa_0001.dat" is huge.
# It takes a long time to read
# (3.63 seconds on a reasonably fast notebook on 2018-09-02)
# and shorter but still long times with other operations
# on "data" (roughly 30 seconds with each computation).
# Therefore, I'm wrapping each computation in a condition,
# so it will only be run if I actually want it.
if(readAndCompute){
#***IF readAndCompute
#***change setwd as needed to
#***the directory containing
#***'usa_00001.xml' and 'usa_00001.dat'
#*** The following is required to knit this .Rmd file
#*** from within ~ecdat/pkg/Ecfun/vignette
#*** when getwd() is at the top of this file stack.
  setwd("../../../..")
  library(ipumsr)
  start.time <- Sys.time()
  ddi <- read_ipums_ddi("usa_00001.xml")
  data <- read_ipums_micro(ddi)
  (et <- Sys.time() - start.time)
}
```

```
## Use of data from IPUMS-USA is subject to conditions including that users should
## cite the data appropriately. Use command `ipums_conditions()` for more details.
```

```
## Time difference of 1.834671 mins
```

I timed this, because the first time it seemed to take a long while. Obviously, I extracted a lot more data than I need. But conveniently, when I’m running this manually, it displays both percent completion and number of MB read so far: 3.63 minutes for "usa_00001.*"

The “data” is an object with a huge number of rows and 8 colums:

```
if(readAndCompute){
  str(data)
```

```
  nrow(data)/1e6
}
```

```
## Classes 'tbl_df', 'tbl' and 'data.frame':    114278279 obs. of  8 variables:
##  $ YEAR   : int  1850 1850 1850 1850 1850 1850 1850 1850 1850 1850 ...
##   ..- attr(*, "label")= chr "Census year"
##   ..- attr(*, "var_desc")= chr "YEAR reports the four-digit year when the household
was enumerated or included in the census, the ACS, and the "| __truncated__
##  $ DATANUM: num  1 1 1 1 1 1 1 1 1 1 ...
##   ..- attr(*, "label")= chr "Data set number"
##   ..- attr(*, "var_desc")= chr "DATANUM identifies the particular sample from which
the case is drawn in a given year. For most censuses, the I"| __truncated__
##  $ SERIAL : num  101 101 101 101 101 101 101 101 101 201 ...
##   ..- attr(*, "label")= chr "Household serial number"
##   ..- attr(*, "var_desc")= chr "SERIAL is an identifying number unique to each
household record in a given sample. All person records are assig"| __truncated__
##  $ HHWT   : num  97 97 97 97 97 97 97 97 97 97 ...
##   ..- attr(*, "label")= chr "Household weight"
##   ..- attr(*, "var_desc")= chr "HHWT indicates how many households in the U.S.
population are represented by a given household in an IPUMS samp"| __truncated__
##  $ GQ     : 'labelled' int  1 1 1 1 1 1 1 1 1 1 ...
##   ..- attr(*, "label")= chr "Group quarters status"
##   ..- attr(*, "var_desc")= chr "GQ classifies all housing units as falling into one of
three main categories: households, group quarters, or va"| __truncated__
##   ..- attr(*, "labels")= Named num  0 1 2 3 4 5 6
##   .. ..- attr(*, "names")= chr  "Vacant unit" "Households under 1970 definition"
"Additional households under 1990 definition" "Group quarters--Institutions" ...
##  $ PERNUM : num  1 2 3 4 5 6 7 8 9 1 ...
##   ..- attr(*, "label")= chr "Person number in sample unit"
##   ..- attr(*, "var_desc")= chr "PERNUM numbers all persons within each household
consecutively in the order in which they appear on the origina"| __truncated__
##  $ PERWT  : num  97 97 97 97 97 97 97 97 97 97 ...
##   ..- attr(*, "label")= chr "Person weight"
##   ..- attr(*, "var_desc")= chr "PERWT indicates how many persons in the U.S.
population are represented by a given person in an IPUMS sample. \"| __truncated__
##  $ OCC1950: 'labelled' int  100 999 999 999 999 999 999 999 999 690 ...
##   ..- attr(*, "label")= chr "Occupation, 1950 basis"
##   ..- attr(*, "var_desc")= chr "Universe Note: \"New Workers\" are persons seeking
employment for the first time, who had not yet secured their"| __truncated__
##   ..- attr(*, "labels")= Named num  0 1 2 3 4 5 6 7 8 9 ...
##   .. ..- attr(*, "names")= chr  "Accountants and auditors" "Actors and actresses"
"Airplane pilots and navigators" "Architects" ...
##  - attr(*, "spec")=List of 2
##   ..$ cols   :List of 8
##   .. ..$ YEAR   : list()
##   .. .. ..- attr(*, "class")= chr  "collector_integer" "collector"
```

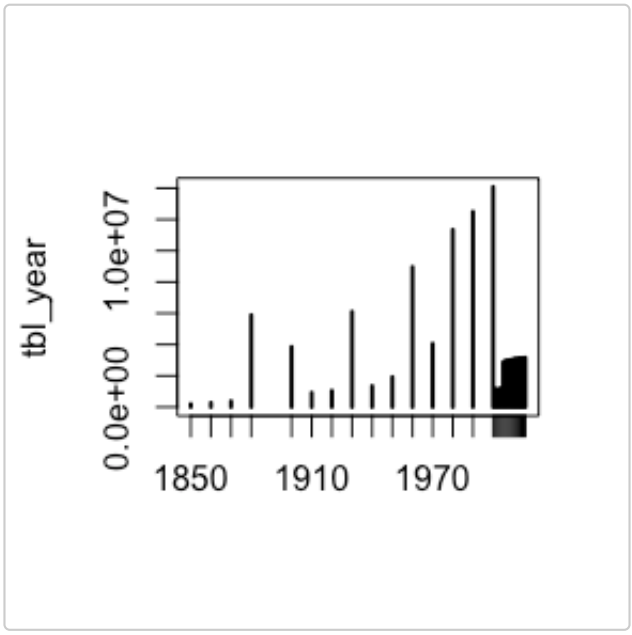
```
##   .. ..$ DATANUM: list()
##   .. .. ..- attr(*, "class")= chr  "collector_double" "collector"
##   .. ..$ SERIAL : list()
##   .. .. ..- attr(*, "class")= chr  "collector_double" "collector"
##   .. ..$ HHWT   : list()
##   .. .. ..- attr(*, "class")= chr  "collector_double" "collector"
##   .. ..$ GQ     : list()
##   .. .. ..- attr(*, "class")= chr  "collector_integer" "collector"
##   .. ..$ PERNUM : list()
##   .. .. ..- attr(*, "class")= chr  "collector_double" "collector"
##   .. ..$ PERWT  : list()
##   .. .. ..- attr(*, "class")= chr  "collector_double" "collector"
##   .. ..$ OCC1950: list()
##   .. .. ..- attr(*, "class")= chr  "collector_integer" "collector"
##   ..$ default: list()
##   .. ..- attr(*, "class")= chr  "collector_skip" "collector"
##   ..- attr(*, "class")= chr "col_spec"


## [1] 114.2783
```

“data” is an object of classes “tbl_df”,“tbl” and “data.frame” with over 114 million rows for “dat00001." *on 2018-09-01, 43 million for "dat00003.”*.

That’s too few rows to have one row for each person in the most recent census – or even one row for each household in all the census since 1850:

```
if(readAndCompute){
  startYr <- Sys.time()
  str(tbl_year <- table(data$YEAR))
  (etYr <- Sys.time()-startYr)
  plot(tbl_year)
  tbl_year
}
```

```
##  'table' int [1:31(1d)] 197796 273596 383358 5882038 3852852 923153 1050634 6103822
1351732 1922198 ...
##  - attr(*, "dimnames")=List of 1
##   ..$ : chr [1:31] "1850" "1860" "1870" "1880" ...
```




```
##
##     1850     1860     1870     1880     1900     1910     1920     1930
##   197796   273596   383358  5882038  3852852   923153  1050634  6103822
##     1940     1950     1960     1970     1980     1990     2000     2001
##  1351732  1922198  8965606  4059942 11343120 12501046 14081466  1192206
##     2002     2003     2004     2005     2006     2007     2008     2009
##  1074628  1194928  1194354  2878380  2969741  2994662  3000657  3030728
##     2010     2011     2012     2013     2014     2015     2016
##  3061692  3112017  3113030  3132795  3132610  3147005  3156487
```

The plot looks funny but shows that we have data from every census except 1890, and that with the listing shows that we also have data for each year between 2000 and 2016 with "dat00001.*".

Let's look at "var_desc" for HHWT:

```
if(readAndCompute){
  attributes(data$HHWT)
}
```

```
## $label
## [1] "Household weight"
##
## $var_desc
## [1] "HHWT indicates how many households in the U.S. population are represented by a
given household in an IPUMS sample. \n\nIt is generally a good idea to use HHWT when
conducting a household-level analysis of any IPUMS sample. The use of HHWT is optional
when analyzing one of the \"flat\" or unweighted IPUMS samples. Flat IPUMS samples
include the 1% samples from 1850-1930, all samples from 1960, 1970, and 1980, the 1%
unweighted samples from 1990 and 2000, the 10% 2010 sample, and any of the full count
```

```
100% census datasets. HHWT must be used to obtain nationally representative statistics
for household-level analyses of any sample other than those.\n\nUsers should also be sure
to select one person (e.g., PERNUM = 1) to represent the entire household.\n\nFor further
explanation of the sample weights, see \"Sample Designs\" [URL omitted from DDI.] and
\"Sample Weights\" [URL omitted from DDI.]. See also PERWT for a corresponding variable
at the person level, and SLWT for a weight variable used with sample-line records in 1940
1% and 1950."
```

Let's look at the distribution of HHWT:

```
if(readAndCompute){
  quantile(data$HHWT)
}
```

```
##   0%  25%  50%  75% 100%
##    0   20   24   85 4331
```

Let's also examine the the attributes of OCC1950:

```
if(readAndCompute){
  stOCC <- Sys.time()
#  str(OCCcodes <- attributes(data$OCC))
  str(OCC50codes <- attributes(data$OCC1950))
  (etOCC <- Sys.time()-stOCC)
}
```

```
## List of 4
##  $ label   : chr "Occupation, 1950 basis"
##  $ var_desc: chr "Universe Note: \"New Workers\" are persons seeking employment for
the first time, who had not yet secured their"| __truncated__
##  $ class   : chr "labelled"
##  $ labels  : Named num [1:283] 0 1 2 3 4 5 6 7 8 9 ...
##   ..- attr(*, "names")= chr [1:283] "Accountants and auditors" "Actors and actresses"
"Airplane pilots and navigators" "Architects" ...
```

```
## Time difference of 0.003780127 secs
```

We're especially interested in "labels":

```
if(readAndCompute){
#  OCCcodes$labels
  print(head(OCC50codes$labels))
  tail(OCC50codes$labels)
```

```
}
```

```
##       Accountants and auditors          Actors and actresses
##                              0                             1
## Airplane pilots and navigators                    Architects
##                              2                             3
##       Artists and art teachers                      Athletes
##                              4                             5
```

```
##                      Inmate                 New Worker
##                         987                        990
##  Gentleman/lady/at leisure       Other non-occupation
##                         991                        995
## Occupation missing/unknown               N/A (blank)
##                         997                        999
```

The “labels” attribute from “OCC1950” provided a translate table giving English-language names to the numeric codes. I didn’t seem to find that when I included “OCC”.

Let’s table:

```
stOCC <- proc.time()
#str(OCCtbl <- table(data$OCC) )
str(OCC50tbl <- table(data$OCC1950))
```

```
##  'table' int [1:281(1d)] 625027 16950 41091 59521 89510 1273 58142 44603 20513 178320
...
##  - attr(*, "dimnames")=List of 1
##   ..$ : chr [1:281] "0" "1" "2" "3" ...
```

```
etOCC <- proc.time()-stOCC
```

When I did this with “OCC”, I got a table of length 1101. Meanwhile the table for “OCC1950” had length only 260. I could have tabled the two together, producing a 2-way table with 260*1101 cells. I decided to give up on “OCC” rather than try that. I also looked briefly at QOCC and decided it was not worth looking further at that.

When I did this with only OCC1950, I got a table of length 281. I don’t know the differences, and I don’t plan to take the time now to research that.

Let’s sum HHWT within YEAR and OCC1950:

```
if(readAndCompute){
  stYrOcc <- proc.time()
  str(YrOcc <- tapply(data$HHWT, data[c("OCC1950", "YEAR")], sum))
```

```
  (etYrOcc <- proc.time()-stYrOcc)
}
```

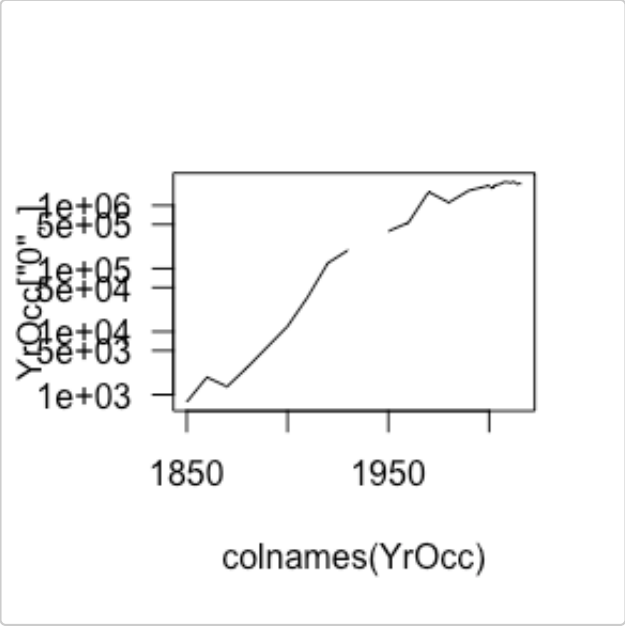
```
##  num [1:281, 1:31] 764 400 NA 397 2130 ...
##  - attr(*, "dimnames")=List of 2
##   ..$ OCC1950: chr [1:281] "0" "1" "2" "3" ...
##   ..$ YEAR   : chr [1:31] "1850" "1860" "1870" "1880" ...
```

```
##    user  system elapsed
##  20.283   3.359  23.949
```

This is an array of OCC1950 by YEAR. The first column should estimate the number of Accountants and Auditors by YEAR.

Let's plot

```
if(readAndCompute){
  plot(colnames(YrOcc), YrOcc['0', ], type='l', log='y', las=1)
}
```



What about the break in this line?

```
if(readAndCompute){
  YrOcc['0',]
}
```

```
##       1850       1860       1870       1880       1900       1910
```

```
##     764.49    1891.97    1345.02    2705.24   12129.25   35307.00
##       1920       1930       1940       1950       1960       1970
##  122104.25  194663.56         NA  390396.00  534680.00 1639800.00
##       1980       1990       2000       2001       2002       2003
## 1113580.00 1724241.00 2064061.00 1889156.00 1931920.00 2096069.00
##       2004       2005       2006       2007       2008       2009
## 2127959.00 2161838.00 2223026.00 2314146.00 2354861.00 2342316.00
##       2010       2011       2012       2013       2014       2015
## 2311519.00 2294479.00 2362162.00 2298363.00 2188585.00 2223301.00
##       2016
## 2217376.00
```

1940 is NA. Is this consistent across all OCC1950 codes?

```
if(readAndCompute){
  (yrNA <- colSums(is.na(YrOcc)))
}
```

```
## 1850 1860 1870 1880 1900 1910 1920 1930 1940 1950 1960 1970 1980 1990 2000
##  116   84   73   34   18   16   10    4   66   10   10   22   60   61   95
## 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015
##   96   96   96   96   96   96   96   96   96   97   97  102  102  102  102
## 2016
##  102
```

Different occupation codes are missing for different years, ranging from 4 OCC1850 codes not used in 1930 to 116 in 1850 and 102 in 2016.

For the purpose of computing the size of the labor force, I think we should treat those NAs as 0, because people nominally with those occupations would probably have been counted in other categories.

```
if(readAndCompute){
  stNA <- proc.time()
  (NA.yr <- colSums(is.na(data)))
  (etNA <- proc.time()-stNA)
}
```

```
##    user  system elapsed
##   3.795   3.172   7.374
```

There were no NAs in “data”.

Note also that there are ony 281 rows in YrOcc, while OCC50codes $labelshaslength 283. Let's find which OCC codes$labels were not used:

```
if(readAndCompute){
  st01 <- proc.time()
  str(OCClbls <- table(data$OCC1950))
  (et01 <- proc.time()-st01)
}
```

```
##  'table' int [1:281(1d)] 625027 16950 41091 59521 89510 1273 58142 44603 20513 178320
...
##  - attr(*, "dimnames")=List of 1
##   ..$ : chr [1:281] "0" "1" "2" "3" ...
```

```
##    user  system elapsed
##  17.501   3.029  20.805
```

```
if(readAndCompute){
  OCC50codes$labels[!(OCC50codes$labels %in% names(OCClbls))]
}
```

```
## Not yet classified         New Worker
##                979                990
```

“Not yet classified” and “New Worker”.

That makes some sense: These codes may have been generated and may even have been used prior to data cleaning operations. If used, they’ve been eliminated from the data I received.

Let’s delete these two and create a logical variable of length 281 indicating which codes are in the labor force (TRUE / FALSE). To start, let’s look at the list of occupational names to see which would not have been counted in the labor force:

```
if(readAndCompute){
  OCC50codes$labels
}
```

```
##                                  Accountants and auditors
##                                                         0
##                                      Actors and actresses
##                                                         1
##                                Airplane pilots and navigators
##                                                         2
##                                                 Architects
##                                                         3
##                                  Artists and art teachers
```

```
##                                                    4
##                                             Athletes
##                                                    5
##                                              Authors
##                                                    6
##                                             Chemists
##                                                    7
##                                        Chiropractors
##                                                    8
##                                            Clergymen
##                                                    9
##                              College presidents and deans
##                                                   10
##          Agricultural sciences-Professors and instructors
##                                                   12
##            Biological sciences-Professors and instructors
##                                                   13
##                     Chemistry-Professors and instructors
##                                                   14
##                     Economics-Professors and instructors
##                                                   15
##                   Engineering-Professors and instructors
##                                                   16
##          Geology and geophysics-Professors and instructors
##                                                   17
##                   Mathematics-Professors and instructors
##                                                   18
##               Medical Sciences-Professors and instructors
##                                                   19
##                      Physics-Professors and instructors
##                                                   23
##                    Psychology-Professors and instructors
##                                                   24
##                    Statistics-Professors and instructors
##                                                   25
##          Natural science (nec)-Professors and instructors
##                                                   26
##          Social sciences (nec)-Professors and instructors
##                                                   27
##        Non-scientific subjects-Professors and instructors
##                                                   28
##          Subject not specified-Professors and instructors
##                                                   29
##                              Dancers and dancing teachers
##                                                   31
##                                             Dentists
##                                                   32
```

```
##                                          Designers
##                                                 33
##                          Dietitians and nutritionists
##                                                 34
##                                          Draftsmen
##                                                 35
##                                 Editors and reporters
##                                                 36
##                                Aeronautical-Engineers
##                                                 41
##                                   Chemical-Engineers
##                                                 42
##                                       Civil-Engineers
##                                                 43
##                                  Electrical-Engineers
##                                                 44
##                                  Industrial-Engineers
##                                                 45
##                                  Mechanical-Engineers
##                                                 46
##                 Metallurgical, metallurgists-Engineers
##                                                 47
##                                    Mining-Engineers
##                                                 48
##                                   Engineers (nec)
##                                                 49
##                                  Entertainers (nec)
##                                                 51
##                       Farm and home management advisors
##                                                 52
##                          Foresters and conservationists
##                                                 53
##                        Funeral directors and embalmers
##                                                 54
##                                    Lawyers and judges
##                                                 55
##                                       Librarians
##                                                 56
##                          Musicians and music teachers
##                                                 57
##                                  Nurses, professional
##                                                 58
##                          Nurses, student professional
##                                                 59
##                               Agricultural scientists
##                                                 61
##                                 Biological scientists
```

```
##                                                 62
##                              Geologists and geophysicists
##                                                 63
##                                        Mathematicians
##                                                 67
##                                           Physicists
##                                                 68
##                               Misc. natural scientists
##                                                 69
##                                        Optometrists
##                                                 70
##                                          Osteopaths
##                                                 71
##                 Personnel and labor relations workers
##                                                 72
##                                         Pharmacists
##                                                 73
##                                        Photographers
##                                                 74
##                              Physicians and surgeons
##                                                 75
##                                       Radio operators
##                                                 76
##                              Recreation and group workers
##                                                 77
##                                     Religious workers
##                                                 78
##                Social and welfare workers, except group
##                                                 79
##                                          Economists
##                                                 81
##                                        Psychologists
##                                                 82
##                           Statisticians and actuaries
##                                                 83
##                                Misc social scientists
##                                                 84
##                           Sports instructors and officials
##                                                 91
##                                         Surveyors
##                                                 92
##                                     Teachers (n.e.c.)
##                                                 93
##                            Medical and dental-technicians
##                                                 94
##                                      Testing-technicians
##                                                 95
```

```
##                                          Technicians (nec)
##                                                        96
##                                Therapists and healers (nec)
##                                                        97
##                                               Veterinarians
##                                                        98
##           Professional, technical and kindred workers (nec)
##                                                        99
##                                Farmers (owners and tenants)
##                                                       100
##                                               Farm managers
##                                                       123
##                                Buyers and dept heads, store
##                                                       200
##                           Buyers and shippers, farm products
##                                                       201
##                                         Conductors, railroad
##                                                       203
##                                              Credit men
##                                                       204
##                           Floormen and floor managers, store
##                                                       205
##                            Inspectors, public administration
##                                                       210
##                      Managers and superintendants, building
##                                                       230
##               Officers, pilots, pursers and engineers, ship
##                                                       240
##  Officials and administratators (nec), public administration
##                                                       250
##                       Officials, lodge, society, union, etc.
##                                                       260
##                                             Postmasters
##                                                       270
##                           Purchasing agents and buyers (nec)
##                                                       280
##                  Managers, officials, and proprietors (nec)
##                                                       290
##                                              Agents (nec)
##                                                       300
##                           Attendants and assistants, library
##                                                       301
##                  Attendants, physicians and dentists office
##                                                       302
##                                  Baggagemen, transportation
##                                                       304
##                                              Bank tellers
```

```
##                                                 305
##                                         Bookkeepers
##                                                 310
##                                            Cashiers
##                                                 320
##                          Collectors, bill and account
##                                                 321
##                  Dispatchers and starters, vehicle
##                                                 322
##        Express messengers and railway mail clerks
##                                                 325
##                                        Mail carriers
##                                                 335
##                           Messengers and office boys
##                                                 340
##                             Office machine operators
##                                                 341
##                        Shipping and receiving clerks
##                                                 342
##          Stenographers, typists, and secretaries
##                                                 350
##                                 Telegraph messengers
##                                                 360
##                                  Telegraph operators
##                                                 365
##                                  Telephone operators
##                                                 370
##             Ticket, station, and express agents
##                                                 380
##           Clerical and kindred workers (n.e.c.)
##                                                 390
##                Advertising agents and salesmen
##                                                 400
##                                       Auctioneers
##                                                 410
##                                      Demonstrators
##                                                 420
##                               Hucksters and peddlers
##                                                 430
##                         Insurance agents and brokers
##                                                 450
##                                          Newsboys
##                                                 460
##                       Real estate agents and brokers
##                                                 470
##                              Stock and bond salesmen
##                                                 480
```

```
##                              Salesmen and sales clerks (nec)
##                                                          490
##                                                       Bakers
##                                                          500
##                                                  Blacksmiths
##                                                          501
##                                                  Bookbinders
##                                                          502
##                                                 Boilermakers
##                                                          503
##                    Brickmasons,stonemasons, and tile setters
##                                                          504
##                                                Cabinetmakers
##                                                          505
##                                                   Carpenters
##                                                          510
##                               Cement and concrete finishers
##                                                          511
##                                 Compositors and typesetters
##                                                          512
##                            Cranemen,derrickmen, and hoistmen
##                                                          513
##                               Decorators and window dressers
##                                                          514
##                                                 Electricians
##                                                          515
##                               Electrotypers and stereotypers
##                                                          520
##                              Engravers, except photoengravers
##                                                          521
##             Excavating, grading, and road machinery operators
##                                                          522
##                                                 Foremen (nec)
##                                                          523
##                                      Forgemen and hammermen
##                                                          524
##                                                    Furriers
##                                                          525
##                                                   Glaziers
##                                                          530
##                           Heat treaters, annealers, temperers
##                                                          531
##               Inspectors, scalers, and graders log and lumber
##                                                          532
##                                           Inspectors (nec)
##                                                          533
##           Jewelers, watchmakers, goldsmiths, and silversmiths
```

```
##                                                    534
##                                  Job setters, metal
##                                                    535
##  Linemen and servicemen, telegraph, telephone, and power
##                                                    540
##                                 Locomotive engineers
##                                                    541
##                                  Locomotive firemen
##                                                    542
##                                        Loom fixers
##                                                    543
##                                         Machinists
##                                                    544
##                          Airplane-mechanics and repairmen
##                                                    545
##                         Automobile-mechanics and repairmen
##                                                    550
##                       Office machine-mechanics and repairmen
##                                                    551
##                  Radio and television-mechanics and repairmen
##                                                    552
##                Railroad and car shop-mechanics and repairmen
##                                                    553
##                             Mechanics and repairmen (nec)
##                                                    554
##                           Millers, grain, flour, feed, etc
##                                                    555
##                                       Millwrights
##                                                    560
##                                     Molders, metal
##                                                    561
##                             Motion picture projectionists
##                                                    562
##                    Opticians and lens grinders and polishers
##                                                    563
##                       Painters, construction and maintenance
##                                                    564
##                                     Paperhangers
##                                                    565
##                       Pattern and model makers, except paper
##                                                    570
##                            Photoengravers and lithographers
##                                                    571
##                         Piano and organ tuners and repairmen
##                                                    572
##                                       Plasterers
##                                                    573
```

```
##                                 Plumbers and pipe fitters
##                                                        574
##                       Pressmen and plate printers, printing
##                                                        575
##                              Rollers and roll hands, metal
##                                                        580
##                                           Roofers and slaters
##                                                        581
##                    Shoemakers and repairers, except factory
##                                                        582
##                                        Stationary engineers
##                                                        583
##                              Stone cutters and stone carvers
##                                                        584
##                                   Structural metal workers
##                                                        585
##                                    Tailors and tailoresses
##                                                        590
##             Tinsmiths, coppersmiths, and sheet metal workers
##                                                        591
##                     Tool makers, and die makers and setters
##                                                        592
##                                               Upholsterers
##                                                        593
##                        Craftsmen and kindred workers (nec)
##                                                        594
##                              Members of the armed services
##                                                        595
##                                  Auto mechanics apprentice
##                                                        600
##                           Bricklayers and masons apprentice
##                                                        601
##                                       Carpenters apprentice
##                                                        602
##                                    Electricians apprentice
##                                                        603
##                         Machinists and toolmakers apprentice
##                                                        604
##                            Mechanics, except auto apprentice
##                                                        605
##                         Plumbers and pipe fitters apprentice
##                                                        610
##                           Apprentices, building trades (nec)
##                                                        611
##                       Apprentices, metalworking trades (nec)
##                                                        612
##                                  Apprentices, printing  trades
```

```
##                                                        613
##                            Apprentices, other specified trades
##                                                        614
##                               Apprentices, trade not specified
##                                                        615
##                                Asbestos and insulation workers
##                                                        620
##                             Attendants, auto service and parking
##                                                        621
##                                          Blasters and powdermen
##                                                        622
##                             Boatmen, canalmen, and lock keepers
##                                                        623
##                                               Brakemen, railroad
##                                                        624
##                                                 Bus drivers
##                                                        625
##                          Chainmen, rodmen, and axmen, surveying
##                                                        630
##                              Conductors, bus and street railway
##                                                        631
##                                         Deliverymen and routemen
##                                                        632
##                    Dressmakers and seamstresses, except factory
##                                                        633
##                                                       Dyers
##                                                        634
##                          Filers, grinders, and polishers, metal
##                                                        635
## Fruit, nut, and vegetable graders, and packers, except facto
##                                                        640
##                              Furnacemen, smeltermen and pourers
##                                                        641
##                                               Heaters, metal
##                                                        642
##                             Laundry and dry cleaning Operatives
##                                                        643
##                Meat cutters, except slaughter and packing house
##                                                        644
##                                                  Milliners
##                                                        645
##                                   Mine operatives and laborers
##                                                        650
##                      Motormen, mine, factory, logging camp, etc
##                                                        660
##                   Motormen, street, subway, and elevated railway
##                                                        661
```

```
##                              Oilers and greaser, except auto
##                                                          662
##                 Painters, except construction or maintenance
##                                                          670
##                                Photographic process workers
##                                                          671
##                                     Power station operators
##                                                          672
##                                      Sailors and deck hands
##                                                          673
##                                                     Sawyers
##                                                          674
##                                           Spinners, textile
##                                                          675
##                                         Stationary firemen
##                                                          680
##                                        Switchmen, railroad
##                                                          681
##                                Taxicab drivers and chauffeurs
##                                                          682
##                                     Truck and tractor drivers
##                                                          683
##                                              Weavers, textile
##                                                          684
##                                     Welders and flame cutters
##                                                          685
##                           Operative and kindred workers (nec)
##                                                          690
##                               Housekeepers, private household
##                                                          700
##                                Laundresses, private household
##                                                          710
##                               Private household workers (nec)
##                                                          720
##                     Attendants, hospital and other institution
##                                                          730
##          Attendants, professional and personal service (nec)
##                                                          731
##                           Attendants, recreation and amusement
##                                                          732
##                         Barbers, beauticians, and manicurists
##                                                          740
##                                                  Bartenders
##                                                          750
##                                                  Bootblacks
##                                                          751
##                             Boarding and lodging house keepers
```

```
##                                                    752
##                                 Charwomen and cleaners
##                                                    753
##                           Cooks, except private household
##                                                    754
##                              Counter and fountain workers
##                                                    760
##                                        Elevator operators
##                                                    761
##                                    Firemen, fire protection
##                                                    762
##                          Guards, watchmen, and doorkeepers
##                                                    763
##          Housekeepers and stewards, except private household
##                                                    764
##                                     Janitors and sextons
##                                                    770
##                                   Marshals and constables
##                                                    771
##                                                Midwives
##                                                    772
##                                   Policemen and detectives
##                                                    773
##                                                Porters
##                                                    780
##                                         Practical nurses
##                                                    781
##                                     Sheriffs and bailiffs
##                                                    782
##                           Ushers, recreation and amusement
##                                                    783
##                                    Waiters and waitresses
##                                                    784
##                     Watchmen (crossing) and bridge tenders
##                                                    785
##              Service workers, except private household (nec)
##                                                    790
##                                               Farm foremen
##                                                    810
##                                 Farm laborers, wage workers
##                                                    820
##                       Farm laborers, unpaid family workers
##                                                    830
##                       Farm service laborers, self-employed
##                                                    840
##                                    Fishermen and oystermen
##                                                    910
```

```
##                 Garage laborers and car washers and greasers
##                                                          920
##                    Gardeners, except farm and groundskeepers
##                                                          930
##                                 Longshoremen and stevedores
##                                                          940
##                      Lumbermen, raftsmen, and woodchoppers
##                                                          950
##                                                    Teamsters
##                                                          960
##                                               Laborers (nec)
##                                                          970
##                                          Not yet classified
##                                                          979
##                Keeps house/housekeeping at home/housewife
##                                                          980
##                          Imputed keeping house (1850-1900)
##                                                          981
##                   Helping at home/helps parents/housework
##                                                          982
##                                         At school/student
##                                                          983
##                                                   Retired
##                                                          984
##                               Unemployed/without occupation
##                                                          985
##                Invalid/disabled w/ no occupation reported
##                                                          986
##                                                    Inmate
##                                                          987
##                                                New Worker
##                                                          990
##                                Gentleman/lady/at leisure
##                                                          991
##                                     Other non-occupation
##                                                          995
##                                Occupation missing/unknown
##                                                          997
##                                               N/A (blank)
##                                                          999
```

“Keeps house/housekeeping at home/housewife, 980” has traditionally not been considered part of the labor force. “Imputed keeping house (1850-1900), 981” should probably be included with that. Similarly, “Helping at home/helps parents/housework, 982” has probably not been traditionally considered part of the labor force. Same with “At school/student, 983” and “Retired, 984”, “Unemployed/without occupation, 985”, “Invalid/disabled w no occupation reported, 986”, “Inmate, 987”, “Gentleman/lady/at leisure, 991”, “Other non-occupaton, 995”, “Occupation missing/unknown, 997”, and “N/A (blank), 999”.

Since “Keeps house … 980” exists, “Housekeepers, private household, 700” must be considered part of the labor force, as with “Laundresses, private household, 710” and “Private household workers (nec), 720”, I think.

What about “Farm laborers, unpaid family workers, 830”? Are these part of the labor force? Probably, being between “Farm laborers, wage workers, 820” and “Farm service laborers, self-employed, 840”.

```
if(readAndCompute){
  LaborForce <- rep(TRUE, length=nrow(YrOcc))
  names(LaborForce) <- rownames(YrOcc)
  LaborForce[as.character(c(980:987, 991, 995, 997, 999))] <- FALSE

  LaborForce[!LaborForce]
  table(LaborForce)

  OccNms <- OCC50codes$labels[OCC50codes$labels %in% names(LaborForce)]
  OccNames <- names(OccNms)
  names(OccNames) <- OccNms
  OccNames[!LaborForce]
}
```

```
##                                         980
## "Keeps house/housekeeping at home/housewife"
##                                         981
##          "Imputed keeping house (1850-1900)"
##                                         982
##    "Helping at home/helps parents/housework"
##                                         983
##                           "At school/student"
##                                         984
##                                    "Retired"
##                                         985
##              "Unemployed/without occupation"
##                                         986
## "Invalid/disabled w/ no occupation reported"
##                                         987
##                                     "Inmate"
##                                         991
##                  "Gentleman/lady/at leisure"
##                                         995
##                       "Other non-occupation"
##                                         997
##                "Occupation missing/unknown"
##                                         999
##                                "N/A (blank)"
```

That all looks good.

```
if(readAndCompute){
  str(TotalLaborForce <- colSums(YrOcc[LaborForce, ], na.rm=TRUE))
  plot(names(TotalLaborForce), TotalLaborForce, type='l', log='y',
     las=1)
  TotalLaborForce
}
```

```
##  Named num [1:31] 5337210 8378962 12935933 18033591 29271906 ...
##  - attr(*, "names")= chr [1:31] "1850" "1860" "1870" "1880" ...
```

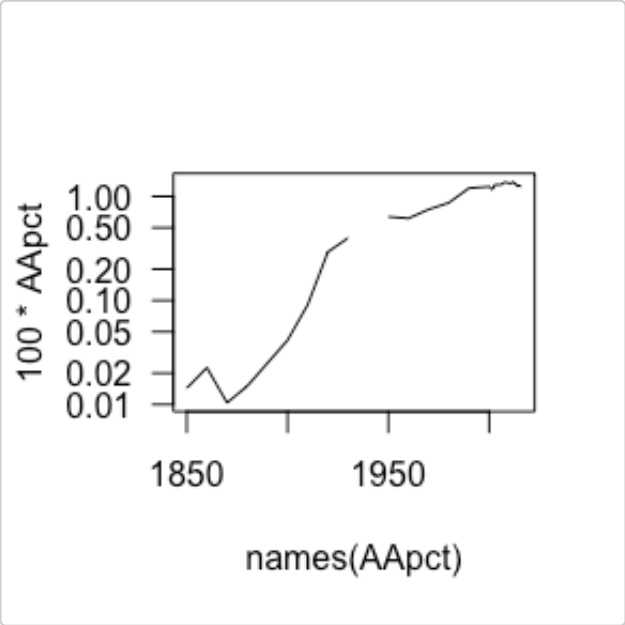

```
##      1850      1860      1870      1880      1900      1910      1920
##   5337210   8378962  12935933  18033591  29271906  38878405  41794569
##      1930      1940      1950      1960      1970      1980      1990
##  49023147  51508164  61353379  86905200 219049800 128412700 143783301
##      2000      2001      2002      2003      2004      2005      2006
## 166544358 159068575 161437410 162253758 164259225 166918520 171604050
##      2007      2008      2009      2010      2011      2012      2013
## 172724909 172853102 172977129 173049142 171466219 172587199 173424328
##      2014      2015      2016
## 174497753 175731168 177135176
```

The number for 1970 seems suspect at 219 million, but the other numbers look plausible and roughly consistent with other sources. In particular, they seem more consistent with the Bicentennial Edition: Historical Statistics of the United States, Colonial Times to 1970 than the Labor Force numbers (items Ba1033 and Ba1159) in the more recent Historical Statistics of the United States, whose numbers for "Accountants and auditors" (item Ba1161) seem to contain some fairly blatant errors, e.g., 0 for 1940 and

1700 and 1200 for 1860 and 1870, respectively, while the labor force grew by over 40% in that decade. Let's look at the ratio, being "Accountants and auditors" as a percent of the labor force:

```
if(readAndCompute){
  str(AApct <- (YrOcc["0", ] / TotalLaborForce))
  plot(names(AApct), 100*AApct, type='l', log='y', las=1)
  AApct
}
```

```
##  Named num [1:31] 0.000143 0.000226 0.000104 0.00015 0.000414 ...
##  - attr(*, "names")= chr [1:31] "1850" "1860" "1870" "1880" ...
```



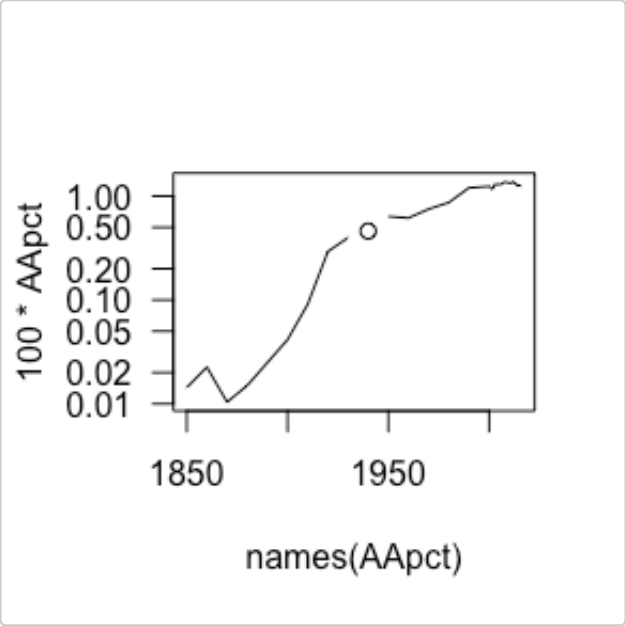

```
##         1850         1860         1870         1880         1900
## 0.0001432378 0.0002258001 0.0001039755 0.0001500112 0.0004143649
##         1910         1920         1930         1940         1950
## 0.0009081391 0.0029215339 0.0039708499           NA 0.0063630725
##         1960         1970         1980         1990         2000
## 0.0061524512 0.0074859689 0.0086718837 0.0119919420 0.0123934610
##         2001         2002         2003         2004         2005
## 0.0118763621 0.0119669908 0.0129184620 0.0129548827 0.0129514568
##         2006         2007         2008         2009         2010
## 0.0129543912 0.0133978707 0.0136234813 0.0135411890 0.0133575872
##         2011         2012         2013         2014         2015
## 0.0133815221 0.0136867741 0.0132528292 0.0125421959 0.0126517170
##         2016
## 0.0125179880
```

These numbers all look reasonably plausible, both internally consistent and moderately consistent with

other sources, apart from the numbers for 1850, 1860 and 1870.

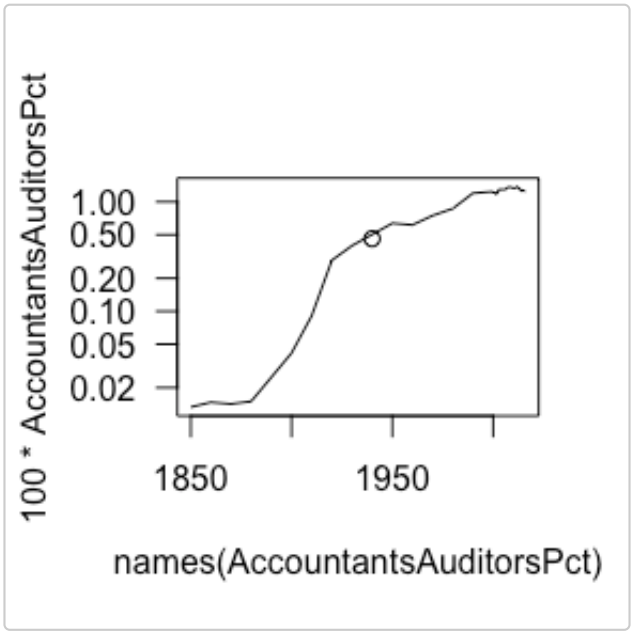
Let's compare this with the 0.46% number for 1940 from the Bicentennial Edition: Historical Statistics of the United States, Colonial Times to 1970, which was used by Wyatt and Hecker (2006) "Occupational changes during the 20th century":

```
if(readAndCompute){
  plot(names(AApct), 100*AApct, type='l', log='y', las=1)
  points(1940, 0.46)
}
```



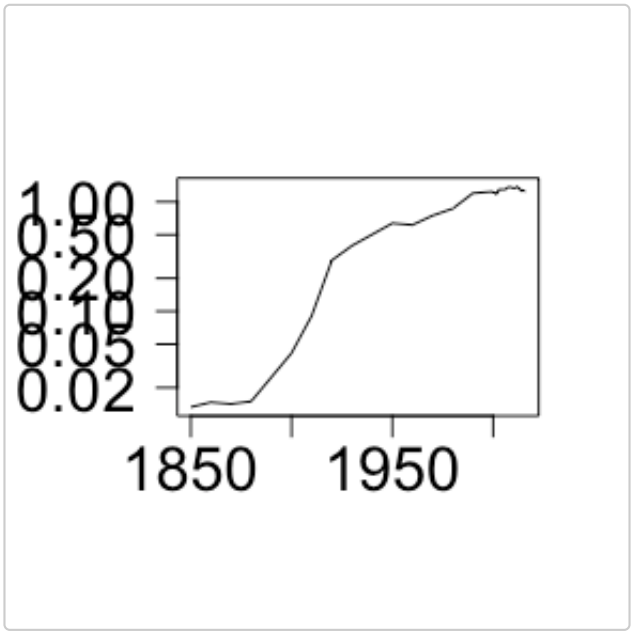
Let's just ignore that NA:

```
if(readAndCompute){
  AccountantsAuditorsPct <- AApct[!is.na(AApct)]
  AccountantsAuditorsPct[1:3] <- c(0.000133, 0.000147, 0.000142)
} else {
  library(Ecdat)
  data(AccountantsAuditorsPct)
}
plot(names(AccountantsAuditorsPct), 100*AccountantsAuditorsPct,
       type='l', log='y', las=1)
points(1940, 0.46)
```



Let's drop the 1940 point from Bicentennial Edition: Historical Statistics of the United States, Colonial Times to 1970 and create an svg file suitable for Wikimedia Commons:

```
plot(names(AccountantsAuditorsPct), 100*AccountantsAuditorsPct,
     type='l', log='y', las=1,
     xlab='', ylab='', cex.axis=1.8)
```




```
if(FALSE){
# To write the file to svg:
  svg('AccountantsAuditorsUS.svg')
  plot(names(AccountantsAuditorsPct), 100*AccountantsAuditorsPct,
     type='l', log='y', las=1,
```

```
      xlab='', ylab='', cex.axis=1.8)
  dev.off()
}
```

Let's now save AccountantsAuditorsPct as *.rda to add to or update the corresponding datat item in the Ecdat package. (Also, an 2018-08-31 "svg" failed to use "cex.axis=1.8" using R 3.5.1 on macOS 10.13.6, but R 3.2.1 under Windows 7 worked as expected. To get around that problem, I saved "AccountantsAuditorsPct" and ported it to another platform, where "svg" worked as advertised.)

```
if(FALSE){
  save(AccountantsAuditorsPct, file='AccountantsAuditorsPct.rda')
}
```