College Financial Data

Code

Desiree Brinn-Rodriguez

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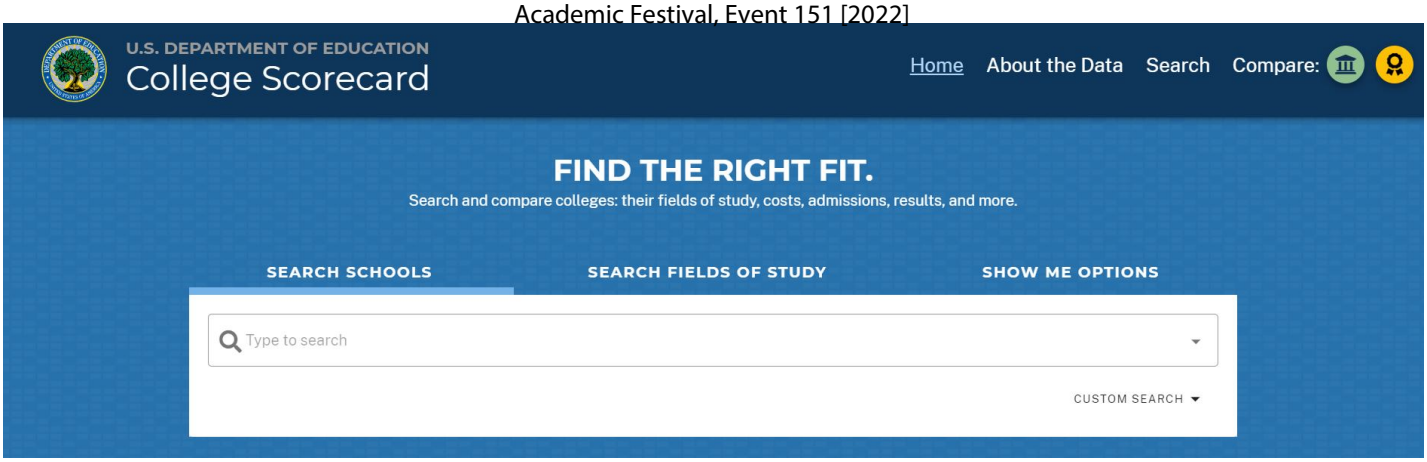
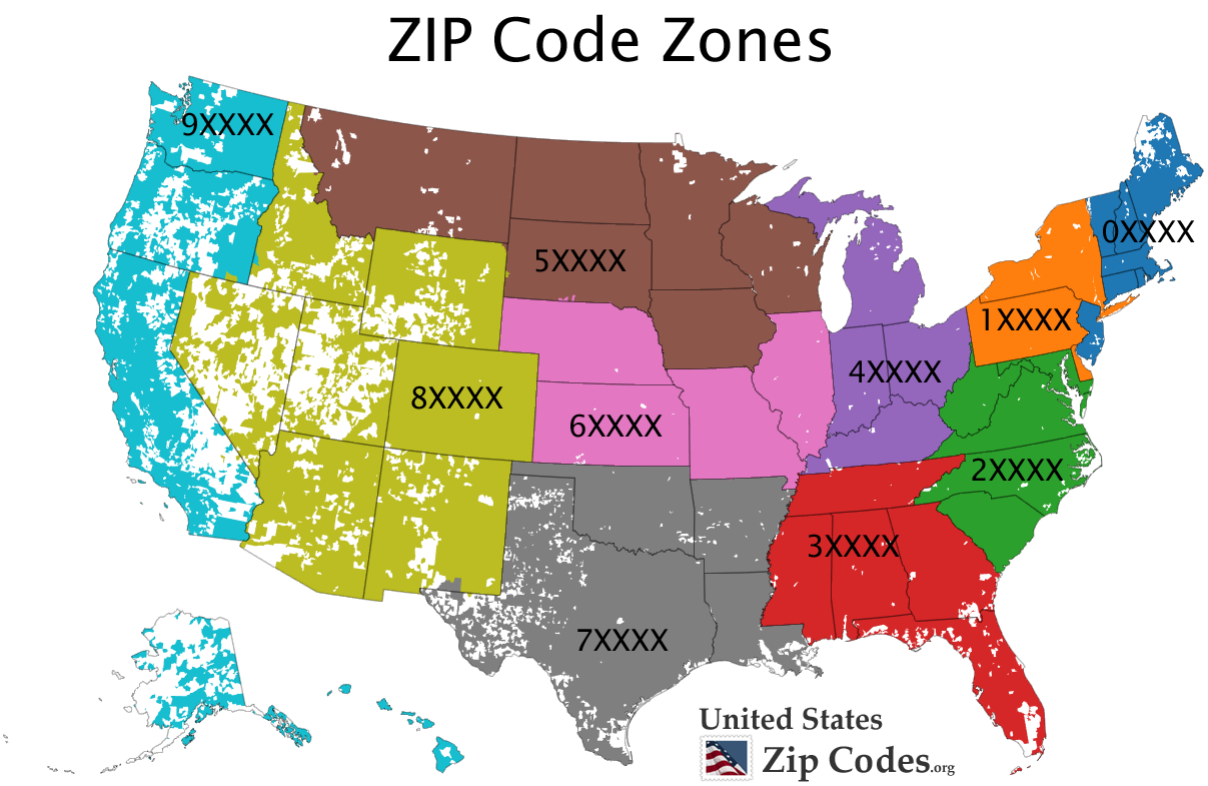
Introduction

This analysis explores College Scorecard information available from the Department of Education's Open Data Platform. The College Scorecard is an aggregation of data from higher education institutions across the United States. Prospective students can go to https://collegescorecard.ed.gov/ (https://collegescorecard.ed.gov/) to compare colleges in terms of several categories, such as cost, loan debt, graduation rate, and retention rate. Much of this data stems from the Integrated Post-secondary Education Data System (IPEDS), a survey instituted by the National Center for Education Statistics (NCES) that has oversight from the U.S. Department of Education. This program collects annual data from colleges and universities who participate in federal financial aid programs (ED, 2021). While the College Scorecard dataset is extensive (original dataset contained 2,392 columns), this focus has been narrowed to specific aspects of college financials: total cost of attendance, tuition revenue, average family income, average faculty salary, median student debt, and total student loan debt. The main factors for comparison include a geographical breakdown by zip code and school type: public, private non-profit, and proprietary (for-profit). Much of this information is derived from student information provided on their FAFSA (Free Application for Federal Student Aid), institutional databases, and the National Student Loan Data System (NSLDS). While the College Scorecard exists for a prospective applicant to view institutions individually or compare side-by-side, this analysis seeks to gain an understanding of financial areas of concern from the totality of colleges in the Scorecard dataset.



(U.S. Department of Education, n.d.)



(UnitedStatesZipCodes.org, 2021)

Data Structure:

Code

```
## [1] "C:/Users/dbrin/Desktop/CS Big Data/Final_Project"
```

Code

```
## [1] "C:/Users/dbrin/Desktop/CS Big Data/Final_Project"
```

Code

```
## 'data.frame':    2746 obs. of  21 variables:
##  $ IPEDSID     : int  426314 134130 176947 217235 231420 236133 100654 101189 101709 100724
...
##  $ OPEID       : int  147900 153500 245300 340400 370200 378300 100200 100300 100400 100500
...
##  $ Name        : chr  "Embry-Riddle Aeronautical University-Worldwide" "University of Florid
a" "Central Methodist University-College of Liberal Arts and Sciences" "Johnson & Wales Universi
ty-Providence" ...
##  $ City        : chr  "Daytona Beach" "Gainesville" "Fayette" "Providence" ...
##  $ State       : chr  "FL" "FL" "MO" "RI" ...
##  $ ZipFactor   : Factor w/ 10 levels "0","1","2","3",..: 4 4 7 1 3 10 4 4 4 4 ...
##  $ Zip         : chr  "32114-3900" "32611-3150" "65248-1198" "02903-3703" ...
##  $ SchoolType  : Factor w/ 3 levels "Private-Nonprofit",..: 1 3 1 1 1 1 3 1 3 3 ...
##  $ Lat         : num  29.2 29.6 39.2 41.8 36.6 ...
##  $ Long        : num  -81 -82.3 -92.7 -71.4 -79.4 ...
##  $ Undergrads  : int  10171 34523 1144 6033 884 903 5271 1928 2200 3750 ...
##  $ TotalCost   : int  23464 21151 38456 49107 46388 43017 23053 34317 24746 21866 ...
##  $ RevenueFT   : int  11302 7493 18439 16355 15982 17647 7870 11127 7918 9587 ...
##  $ ExpensesFT  : int  5919 16395 13097 8978 9449 9331 5546 5881 12066 9346 ...
##  $ SalaryAVG   : int  7290 11831 6388 9732 6038 6888 7709 6001 7756 7221 ...
##  $ DefaultRate : num  0.047 0.02 0.079 0.094 0.089 0.041 0.176 0.098 0.077 0.18 ...
##  $ DebtMDN     : int  13625 14831 12317 16500 16737 14000 15500 14925 15750 18679 ...
##  $ FamIncomeAVG: num  58583 58287 49458 61769 54227 ...
##  $ Grads       : int  3469 17002 NA 572 NA 392 899 844 317 440 ...
##  $ LoanCount   : int  34950 91026 12242 72353 10106 6438 31374 20118 10663 34246 ...
##  $ LoanTotal   : num  7.64e+08 2.75e+09 2.14e+08 1.37e+09 2.33e+08 ...
```

Cleaning Dataset

In tackling a large dataset, I first narrowed my focus to columns related to financial information and loan debt. I removed columns related to academics. Additionally, the dataset included rows with fields marked “Privacy Suppressed” or NULL. These rows were removed from the dataset. In order to focus this presentation, columns related to specific groups for debt median (by gender, race, and first-generation college status) were removed. There were 6 duplicate OPEIDs for branch campuses; in these cases, rows were kept based on the brick-and-mortar location. Originally, I was reviewing a loan volume report for Award Year 2020-2021 Q4 from the Federal Student Aid Data Center. This included federal student loan disbursement information as well as the designation of an institution’s school type (Federal Student Aid, 2021). In Excel, I used a vertical lookup function to add the column “SchoolType” to my College Scorecard data through an OPEID (Office of Post-secondary Education Identifier) match (ED, 2021). I also used an Excel LEFT function to parse out the first digit of the zip code. The resulting spreadsheet was saved as a .csv file titled “CollegeScorecardData.”

Data Summary and Statistics

In a walkthrough of the columns, the dataset includes IPEDSID and OPEID (identifiers/keys for the dataset). This is followed by general information: college name, city, state, geographical information and school type. The undergrads column indicates the total number of enrolled undergraduate students. This column is followed by the total cost of attendance, revenue per full-time student, expenses per full-time student, average faculty salary (per month), federal loan default rate, debt median, average family income, total number of graduate students, the

count of federal loan recipients with outstanding balances, and the total dollar amount of these loan recipient balances. These balances do not include parent or graduate PLUS loans. According to the Scorecard Technical Documentation, this data is derived from the 2019-2020 award year from July 1, 2019 to June 30, 2020 (2021).

As seen in the summary below, this dataset provides a wide range of values. For example, the range of undergraduate students goes from 7 to over 98,360. When compared to the mean in this category of 4955, we can tell that the upper limit of this range is extreme. Other notable statistics include the average total cost of attendance ($29,228), the debt median ($12,500), the highest default rate (47.3%), the highest outstanding loan balances owed ($37,427,769,280).

The total number of colleges in this dataset is 2,746. The total amount of outstanding loan balances for all institutions in the dataset is:

Code

```
## [1] 992323075073
```

This is a summary of the data:

Code

```
##     IPEDSID           OPEID             Name               City
##  Min.   :100654   Min.   : 100200   Length:2746        Length:2746
##  1st Qu.:152646   1st Qu.: 215325   Class :character   Class :character
##  Median :188766   Median : 335200   Mode  :character   Mode  :character
##  Mean   :203765   Mean   : 811960
##  3rd Qu.:221714   3rd Qu.: 815250
##  Max.   :489937   Max.   :4281700
##
##     State              ZipFactor       Zip                         SchoolType
##  Length:2746        9      :381   Length:2746        Private-Nonprofit:1110
##  Class :character   1      :345   Class :character   Proprietary      : 314
##  Mode  :character   3      :292   Mode  :character   Public           :1322
##                     0      :278
##                     2      :277
##                     4      :277
##                     (Other):896
##       Lat              Long           Undergrads        TotalCost
##  Min.   :13.43   Min.   :-159.40   Min.   :    7.0   Min.   : 6525
##  1st Qu.:34.24   1st Qu.: -97.16   1st Qu.:  896.2   1st Qu.:14932
##  Median :39.19   Median : -86.79   Median : 2078.0   Median :24176
##  Mean   :38.06   Mean   : -90.58   Mean   : 4954.9   Mean   :29228
##  3rd Qu.:41.80   3rd Qu.: -78.87   3rd Qu.: 5793.8   3rd Qu.:40467
##  Max.   :64.86   Max.   : 144.80   Max.   :98630.0   Max.   :78555
##
##    RevenueFT       ExpensesFT       SalaryAVG      DefaultRate
##  Min.   :    0   Min.   :   453   Min.   :  940   Min.   :0.00000
##  1st Qu.: 3939   1st Qu.:  5383   1st Qu.: 5732   1st Qu.:0.04800
##  Median : 9448   Median :  7522   Median : 7078   Median :0.08700
##  Mean   :10797   Mean   :  9131   Mean   : 7355   Mean   :0.09893
##  3rd Qu.:15192   3rd Qu.: 10450   3rd Qu.: 8650   3rd Qu.:0.14300
##  Max.   :52786   Max.   :132974   Max.   :20988   Max.   :0.47300
##
##     DebtMDN       FamIncomeAVG        Grads           LoanCount
##  Min.   : 1834   Min.   :  4181   Min.   :    1.0   Min.   :     80
##  1st Qu.: 7776   1st Qu.: 31085   1st Qu.:  186.2   1st Qu.:   3923
##  Median :12500   Median : 45012   Median :  634.5   Median :   8241
##  Mean   :12886   Mean   : 51328   Mean   : 1908.4   Mean   :  17534
##  3rd Qu.:17500   3rd Qu.: 66381   3rd Qu.: 2027.0   3rd Qu.:  19026
##  Max.   :32500   Max.   :174263   Max.   :38561.0   Max.   :1429109
##                                   NA's   :1336
##    LoanTotal
##  Min.   :6.653e+05
##  1st Qu.:4.965e+07
##  Median :1.240e+08
##  Mean   :3.614e+08
##  3rd Qu.:3.579e+08
##  Max.   :3.743e+10
##
```

Enrollment

In this analysis, geom_point graphs with factors show the comparative differences between private, proprietary, and public institutions. Using points also illustrates the handful of high enrollment outliers (the statistical maximums) in each category. From the graphs, public institutions contain the most data points–meaning most institutions are public and service many students. In terms of enrollment, each category has a few outliers that are dominating enrollment numbers. Despite most public universities having generally greater enrollment numbers than private and proprietary colleges, there are two major outliers in the private category that have the highest numbers of students, both of which have strong online presences: Western Governors University and Southern New Hampshire University. The high number of graduate students at proprietary colleges takes them in a lead over public colleges in the total student count.

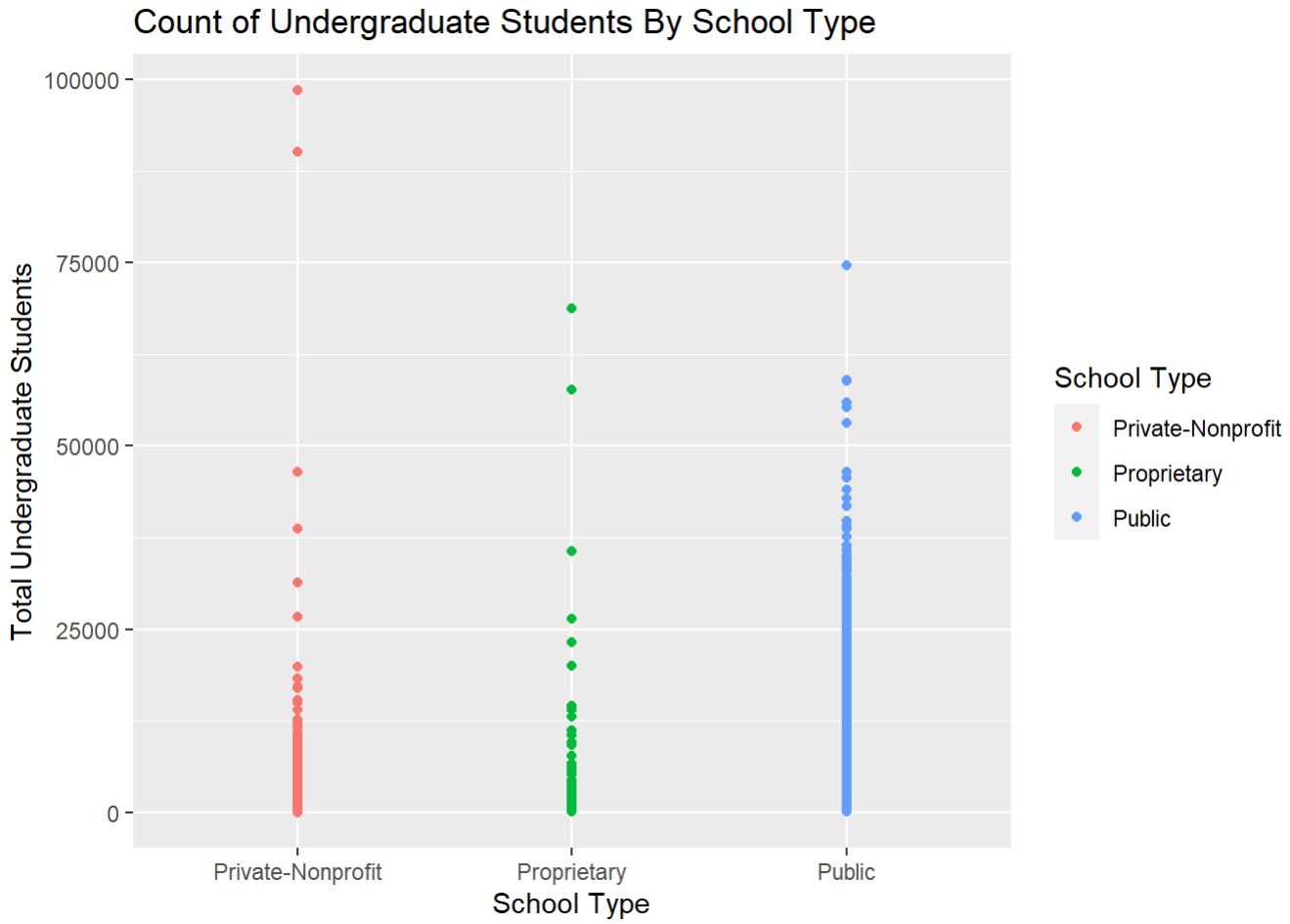
A point-to-point graph displays the geographical breakdown of student enrollment. While the “0” Zip code region/New England is an expected area of high enrollment with its concentration of colleges, the “8” Zip code region (comprised of Arizona, Colorado, Wyoming, Utah, New Mexico, and Nevada) took an unexpected lead as the region with the highest student enrollment. These colleges also tend to have large online presences, such as University of Phoenix and, again, Western Governors University (the statistical maximum).

Top 5 Undergraduate Enrollment:

Code

```
##                                         Name State        SchoolType
## 2570              Western Governors University    UT Private-Nonprofit
## 945          Southern New Hampshire University    NH Private-Nonprofit
## 1374 Pennsylvania State University-Main Campus    PA            Public
## 2341             University of Phoenix-Arizona    AZ       Proprietary
## 2167                Ivy Tech Community College    IN            Public
##      Undergrads
## 2570      98630
## 945       90196
## 1374      74630
## 2341      68833
## 2167      58978
```

Code



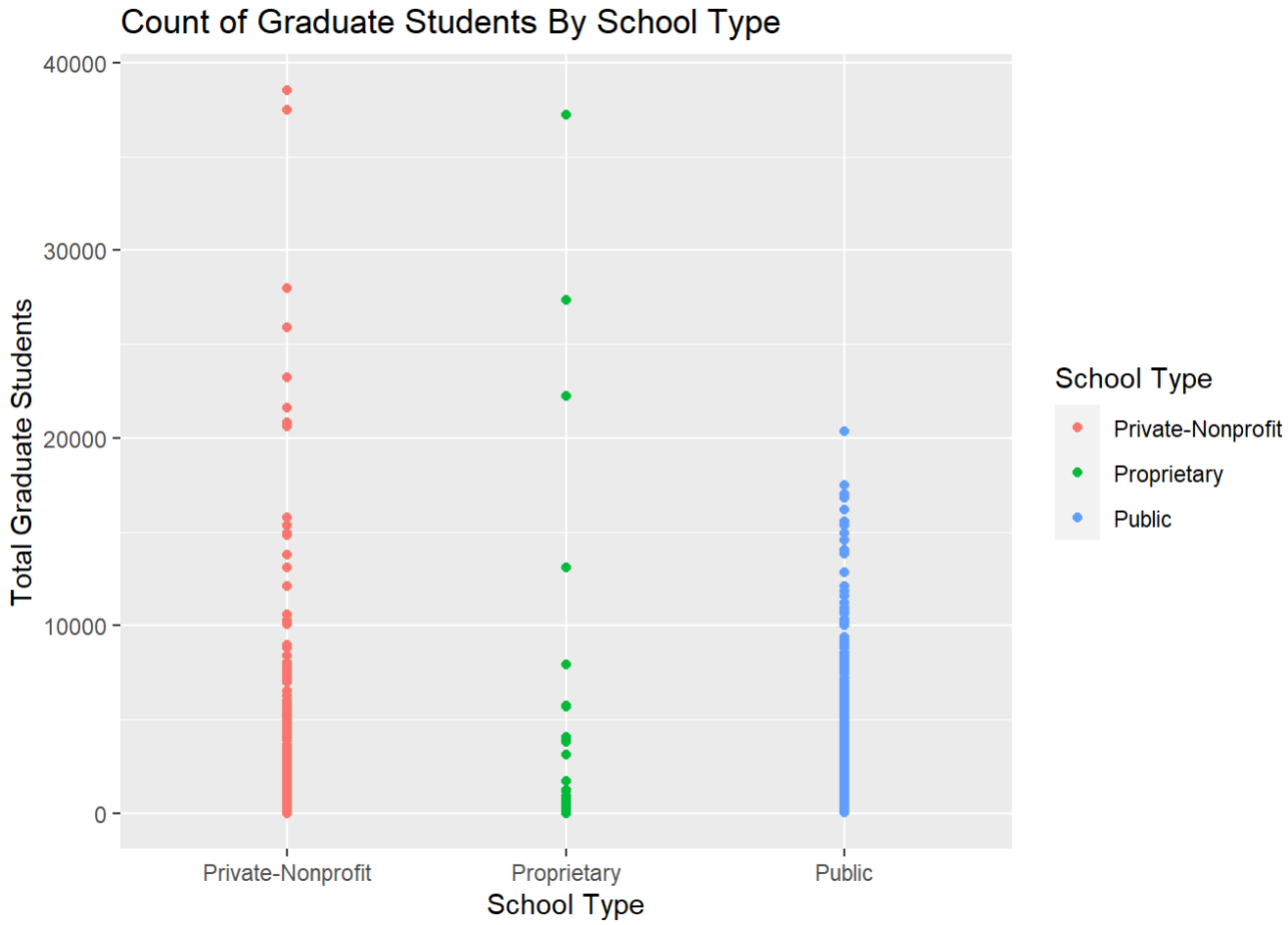
Top 5 Graduate Enrollment:

Code

```
##                                Name State        SchoolType Grads
## 2314               Liberty University    VA Private-Nonprofit 38561
## 2570      Western Governors University    UT Private-Nonprofit 37509
## 45              Grand Canyon University    AZ       Proprietary 37214
## 204  University of Southern California    CA Private-Nonprofit 27970
## 2565               Capella University    MN       Proprietary 27356
```

Code

```
## Warning: Removed 1336 rows containing missing values (geom_point).
```



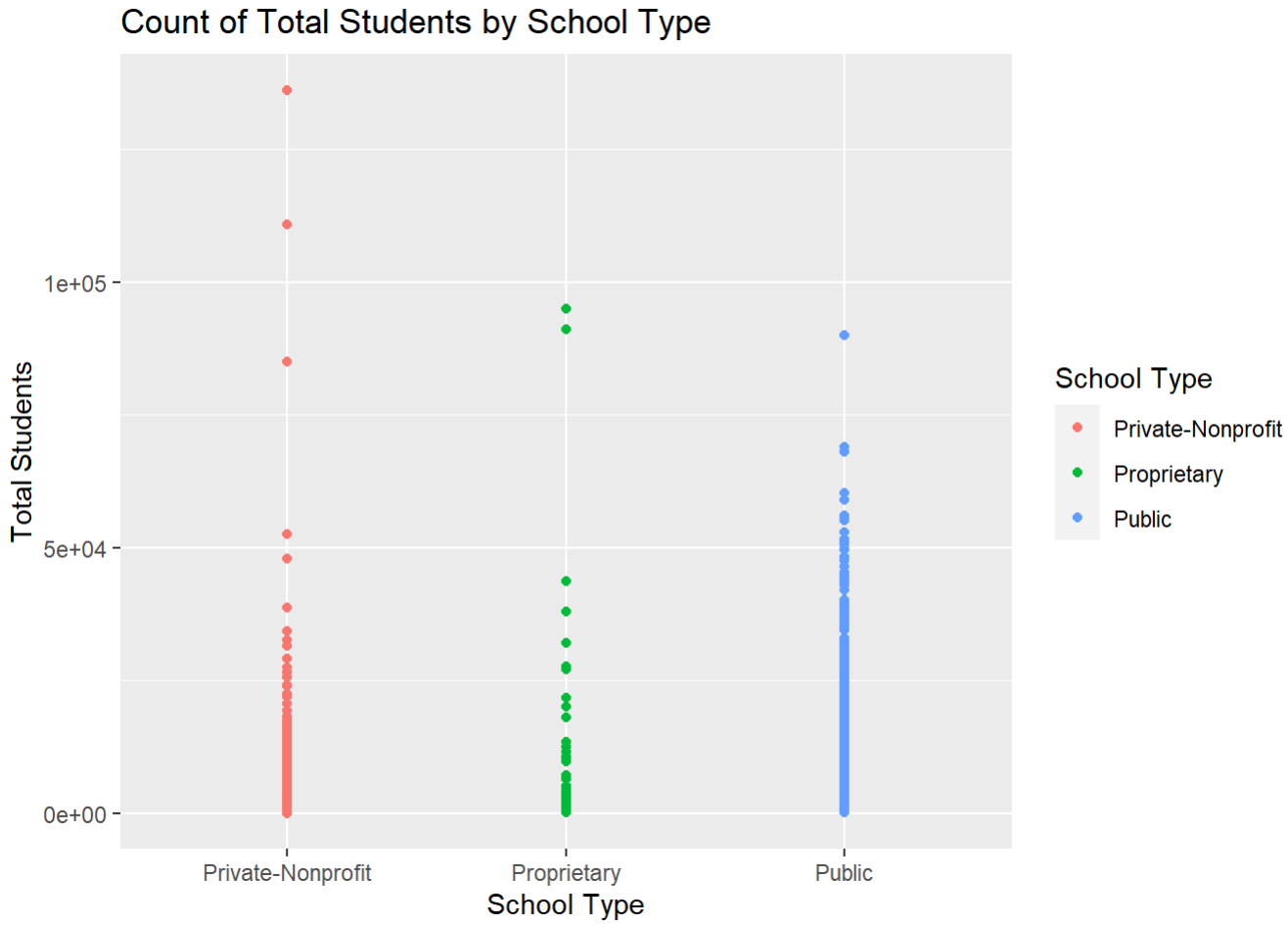
Code

Top 5 Total Enrollment:

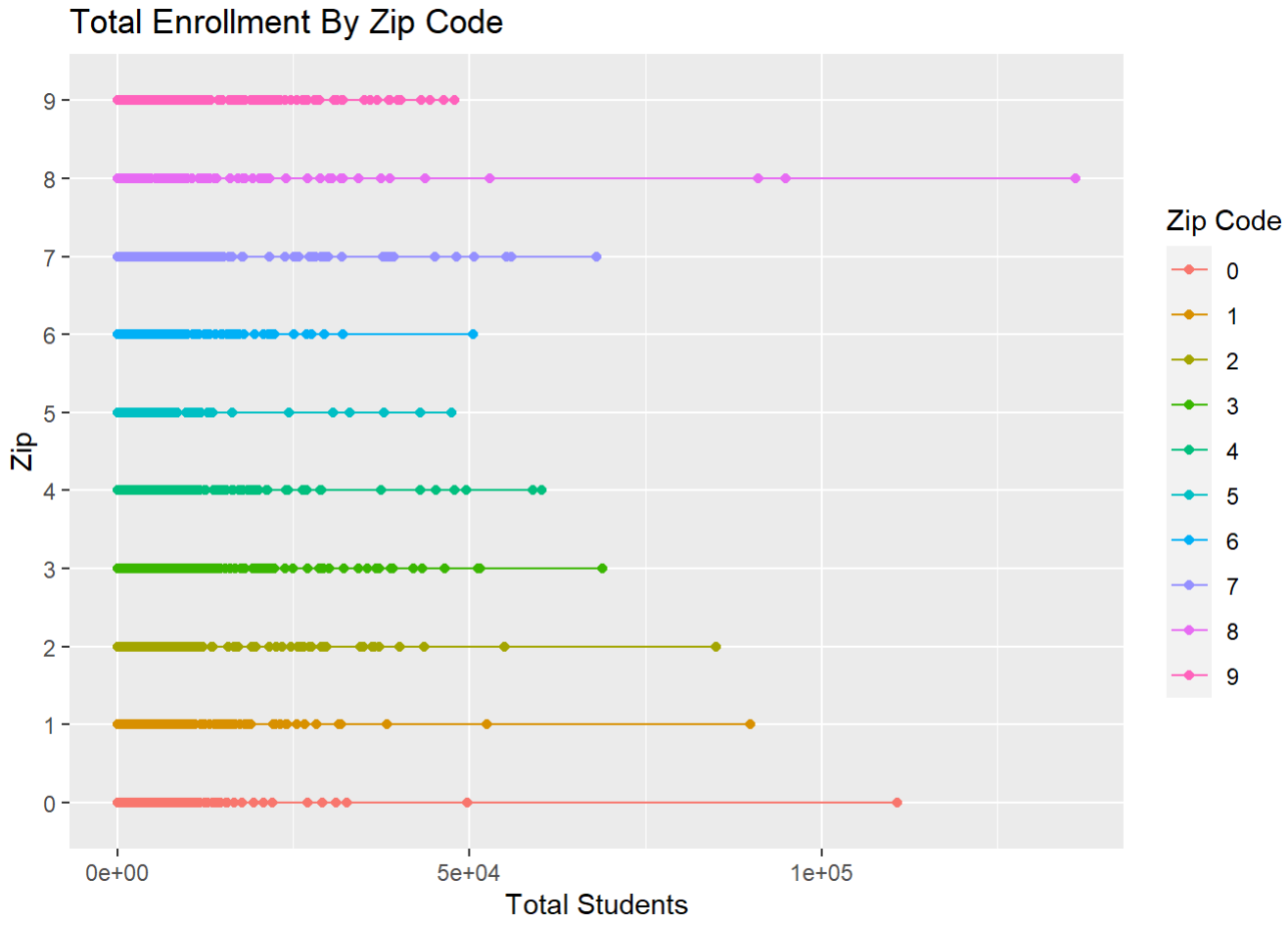
Code

```
##                                       Name State        SchoolType
## 2570              Western Governors University    UT Private-Nonprofit
## 945          Southern New Hampshire University    NH Private-Nonprofit
## 45                     Grand Canyon University    AZ       Proprietary
## 2341             University of Phoenix-Arizona    AZ       Proprietary
## 1374 Pennsylvania State University-Main Campus    PA            Public
##      TotalStudents
## 2570        136139
## 945         110808
## 45           94843
## 2341         91072
## 1374         89958
```

Code


Count of Total Students by School Type
Total Students
1e+05
5e+04
0e+00
Private-Nonprofit
Proprietary
Public
School Type
School Type
Private-Nonprofit
Proprietary
Public

Code



College Costs

In examining the total cost of attendance, the dataset refers to both billable and non-billable elements of a student's educational experience, such as tuition, room, board, transportation, and miscellaneous expenses (ED, 2021). In the illustrations below, we see that private colleges maintain the highest costs whereas public institutions are the most cost-effective.

The geographical comparison presents zip code region "8" (which had the highest student enrollment) as the least expensive region for students. The Northeast (zip code regions "0" and "1") have a large concentration of colleges with comparatively high costs. The jitter function on the graph illustrates the various clusters of colleges that fall outside the quartile ranges.

Top 5 Cost Examples:

Code

```
##                                          Name State        SchoolType
## 445                        University of Chicago    IL Private-Nonprofit
## 113                          Harvey Mudd College    CA Private-Nonprofit
## 1013 Columbia University in the City of New York    NY Private-Nonprofit
## 1390                  University of Pennsylvania    PA Private-Nonprofit
## 1136                              Duke University    NC Private-Nonprofit
##      TotalCost
## 445      78555
## 113      76953
## 1013     76907
## 1390     75303
## 1136     75105
```

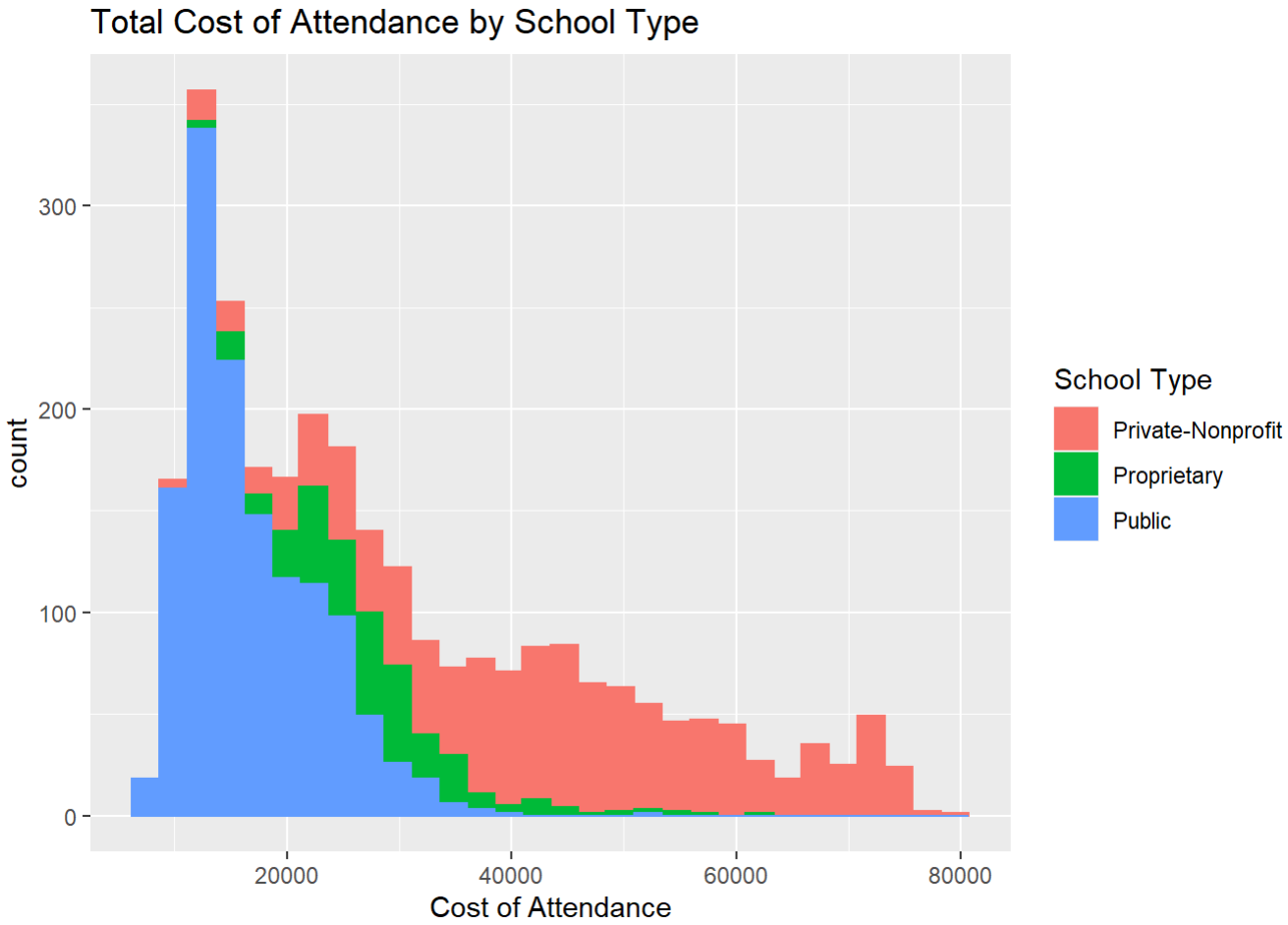
Bottom 5 Cost Examples:

Code

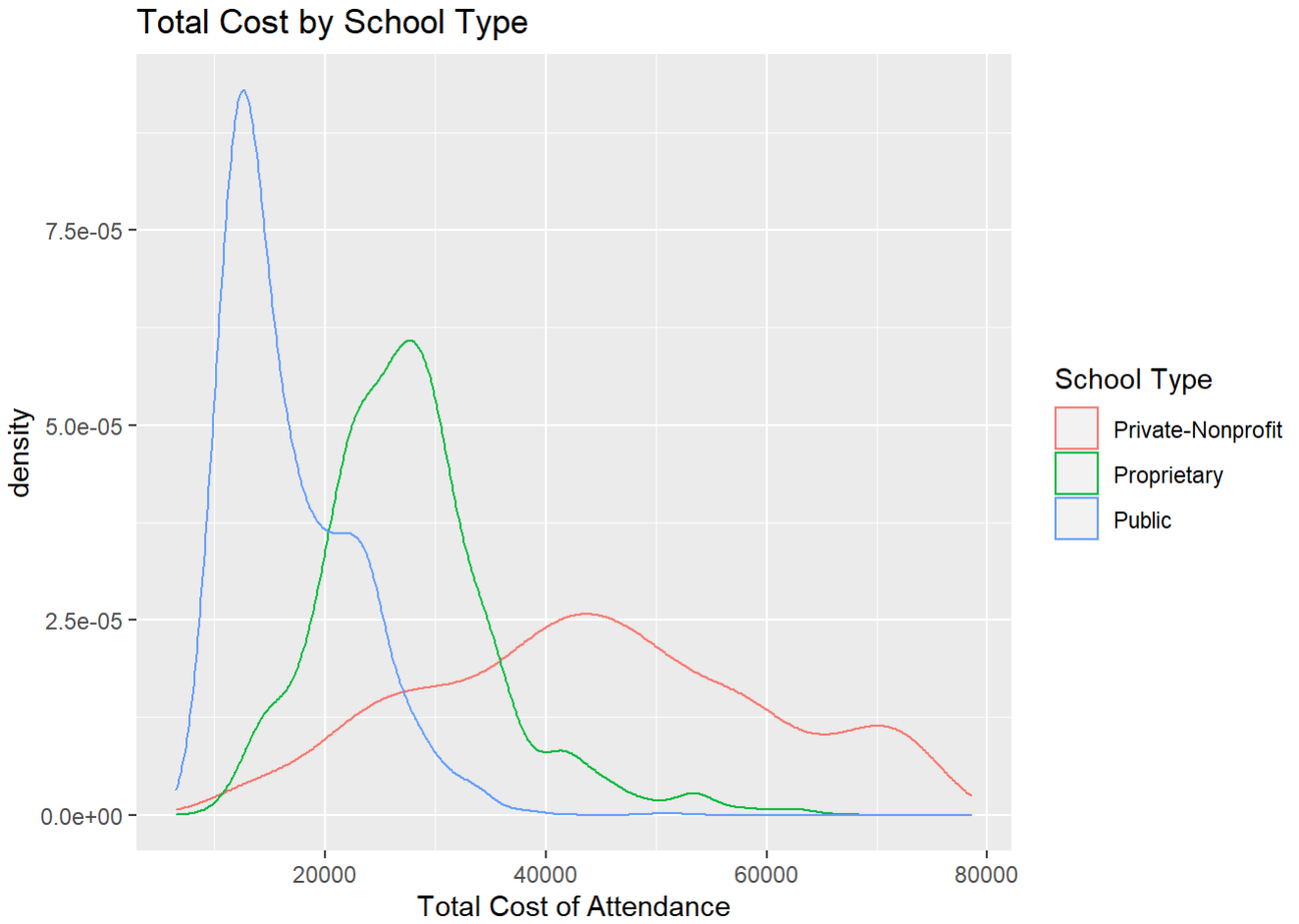
```
##                                       Name State SchoolType TotalCost
## 1216        Lorain County Community College    OH     Public      7900
## 1966                College of the Mainland    TX     Public      7871
## 2463           St Charles Community College    MO     Public      7364
## 2281 Chattahoochee Valley Community College    AL     Public      7338
## 288               Indian River State College    FL     Public      6525
```

Code

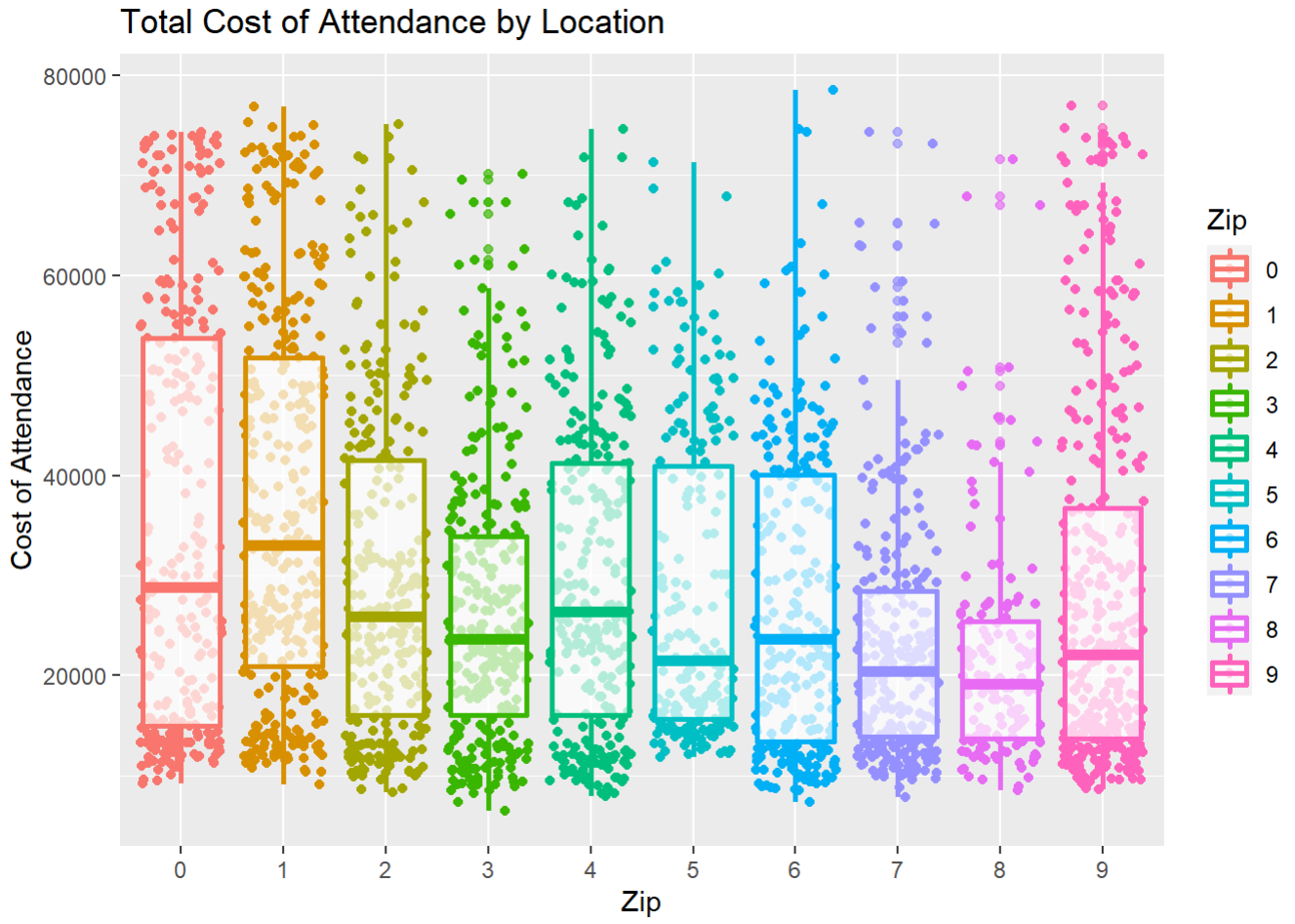
```
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```


Total Cost of Attendance by School Type
count
300
200
100
0
20000
40000
60000
80000
Cost of Attendance
School Type
Private-Nonprofit
Proprietary
Public

Code


Total Cost by School Type
7.5e-05
5.0e-05
2.5e-05
0.0e+00
density
20000
40000
60000
80000
Total Cost of Attendance
School Type
Private-Nonprofit
Proprietary
Public

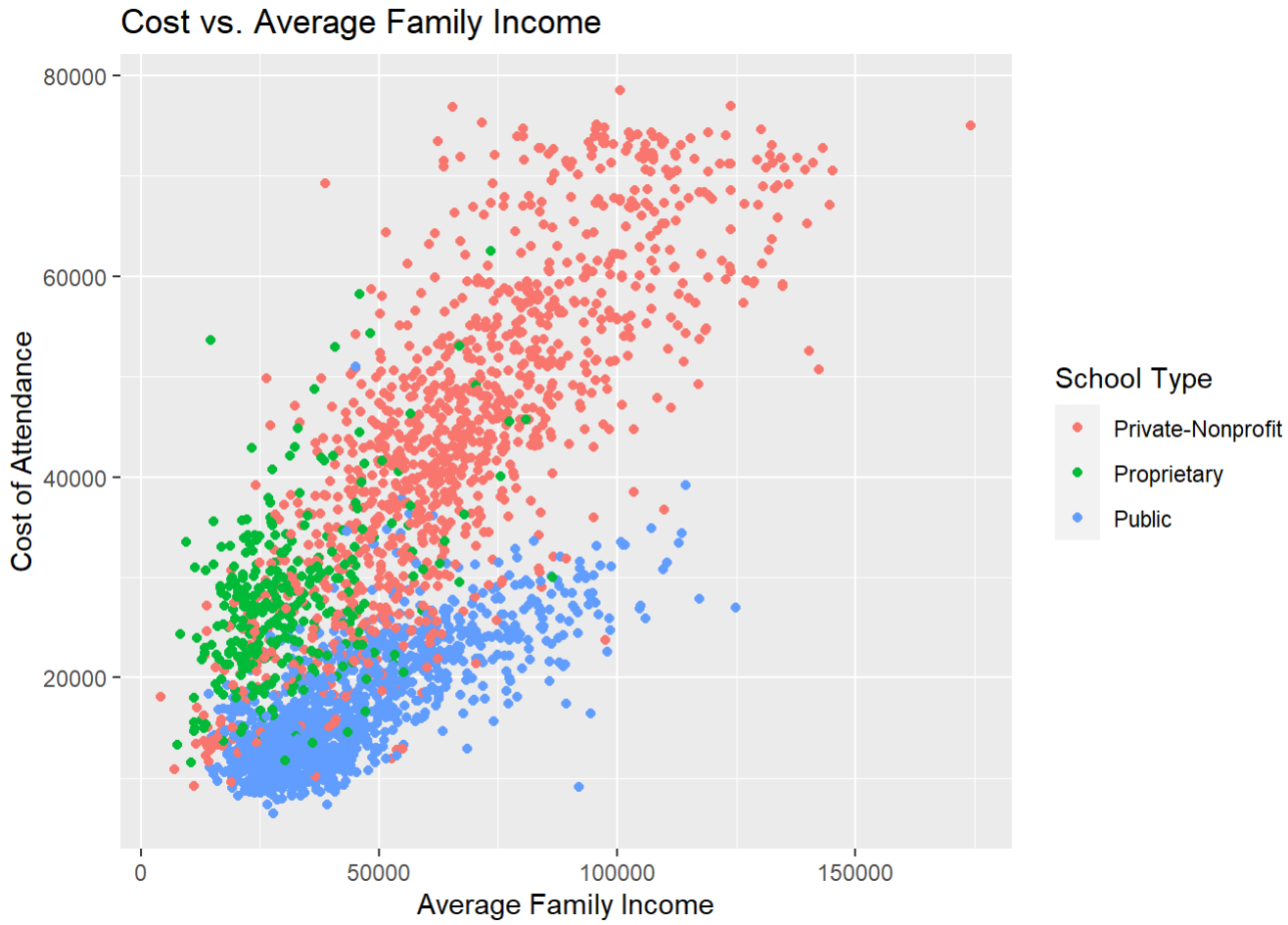
Code



Clustering Example

The graph below shows the relationship between average family income and college cost of attendance. Families with higher incomes are enrolling in more expense private colleges whereas lower income households are enrolling in public universities or proprietary institutions. In clustering this graph, the end result shows a breakdown of colleges catered to three separate economic tiers: lower, middle, and upper class.

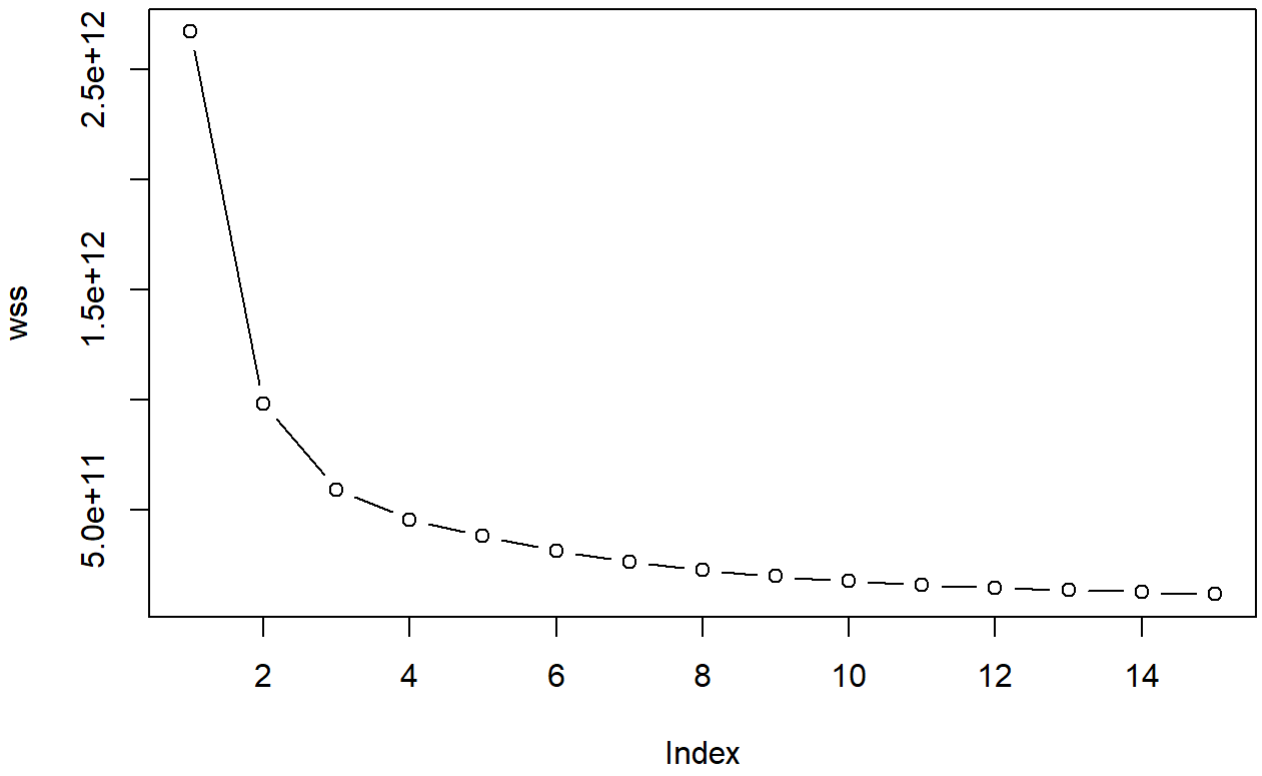
Code



Code

```
## Warning: did not converge in 10 iterations
```

Code

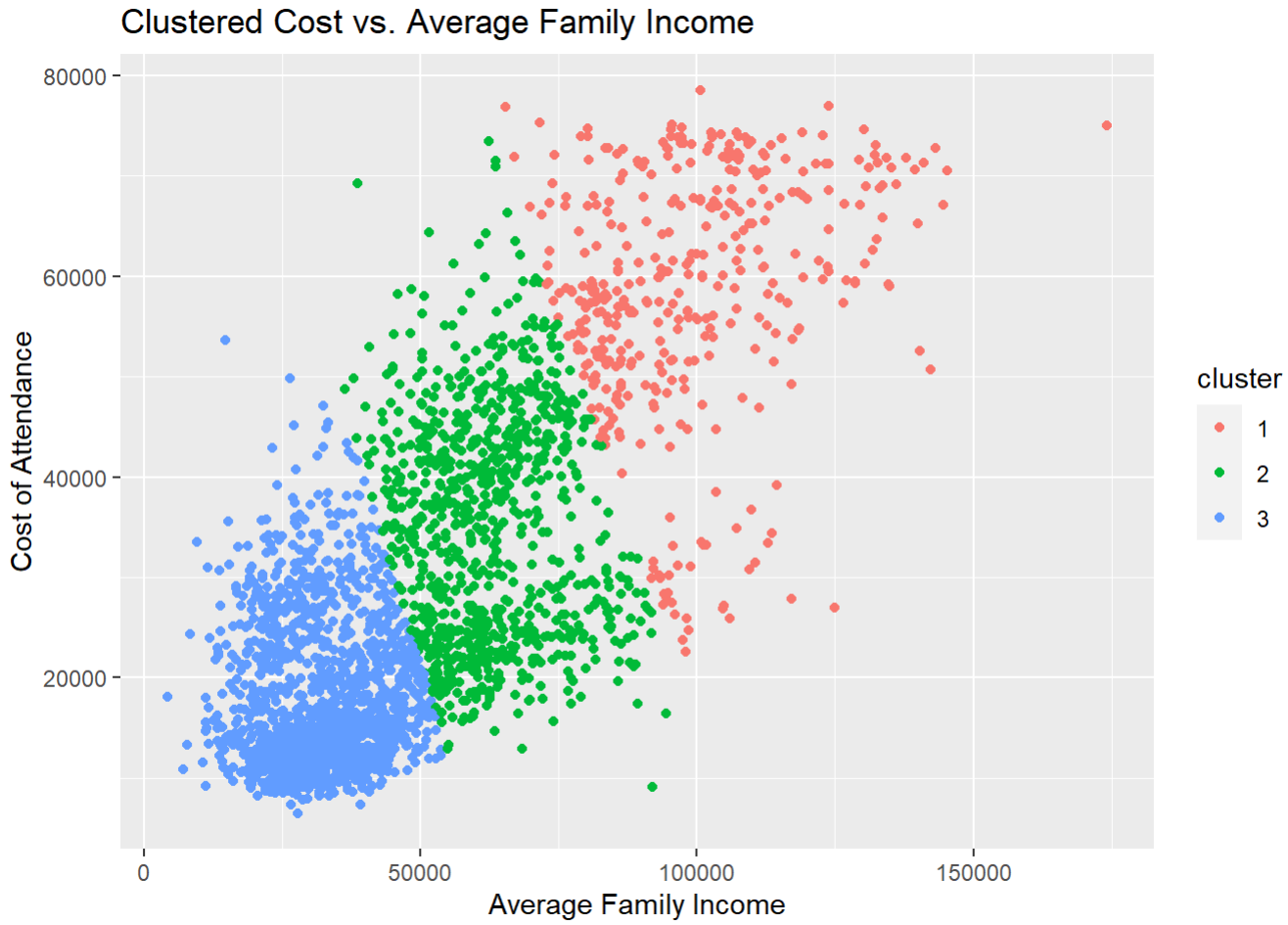


Code

```
## K-means clustering with 3 clusters of sizes 880, 383, 1483
##
## Cluster means:
##       [,1]     [,2]
## 1 62643.26 35274.26
## 2 99277.62 58414.77
## 3 32230.62 18102.86
##
## Clustering vector:
##    [1] 1 1 1 1 1 1 3 3 1 3 3 2 1 3 3 1 1 3 3 3 3 1 3 1 3 1 2 3 3 2 3 3 3 1 2 1 1
##   [38] 1 3 1 3 3 3 3 1 3 3 3 3 1 1 1 3 3 3 1 3 3 3 1 1 1 3 1 3 2 1 3 1 3 3 1 3 1
##   [75] 3 3 3 1 1 3 2 3 1 1 2 2 2 1 3 3 3 3 3 3 2 3 3 3 3 3 1 3 3 3 1 3 3 3 3 2 3
##  [112] 2 2 2 2 2 3 1 3 1 3 1 3 3 3 3 3 3 3 2 3 3 3 3 3 3 3 3 3 1 1 3 3 1 3 3 3 3
##  [149] 3 3 3 3 1 1 3 3 1 3 3 2 3 1 1 1 1 3 3 2 3 3 3 3 3 3 2 3 1 3 3 3 3 3 3 3 1
##  [186] 3 1 3 2 2 3 3 1 1 1 1 1 1 1 1 2 2 2 2 1 3 3 1 2 2 1 3 3 3 2 2 1 1 1 3 1 3
##  [223] 3 3 3 1 1 3 2 2 1 1 1 2 1 2 3 3 1 2 3 3 3 2 2 1 1 2 1 1 2 2 1 2 1 1 2 1 2
##  [260] 1 2 3 3 2 2 1 3 3 1 3 1 1 3 3 3 3 3 3 3 1 3 3 3 2 2 1 3 3 1 3 3 3 3 3 1 3
##  [297] 1 3 3 3 3 3 2 3 3 1 3 3 3 3 2 3 2 3 2 1 3 1 3 1 1 2 3 1 3 3 3 3 1 2 3 2 3 1
##  [334] 3 3 3 1 1 1 1 3 1 1 1 3 1 1 3 1 3 1 1 1 1 3 1 1 1 1 3 1 1 3 3 3 3 3 1 1 3
##  [371] 3 3 3 1 3 1 1 2 1 3 3 3 3 2 3 3 3 3 3 3 3 1 1 1 3 1 1 3 1 1 3 1 1 1 1 1 3
##  [408] 3 2 3 1 2 3 2 1 1 3 2 3 1 1 1 3 3 2 1 1 2 1 3 1 3 1 1 1 3 2 1 1 1 1 1 1 3
##  [445] 2 1 3 1 1 2 3 1 1 1 2 2 1 2 2 1 1 2 1 1 3 1 1 2 3 1 3 3 3 3 1 1 1 1 2 1 2
##  [482] 1 3 1 2 2 1 2 2 3 2 1 1 3 2 1 2 2 3 2 2 3 3 3 1 1 2 1 1 2 2 3 3 1 1 3 2 2
##  [519] 1 1 1 1 1 1 2 1 3 3 1 1 1 3 3 3 3 3 3 3 3 3 1 1 3 1 3 3 3 3 1 1 1 1 3 1 1
##  [556] 3 1 3 1 1 1 1 1 1 3 1 3 1 2 3 1 1 1 2 1 1 1 1 3 1 3 1 3 1 3 3 2 1 1 3 3 3
##  [593] 3 3 3 3 1 1 1 2 3 1 3 1 1 1 3 3 3 3 2 1 3 3 3 1 3 3 2 1 1 3 2 2 2 1 3 1 2
##  [630] 2 2 1 1 1 3 3 1 3 3 1 3 3 3 1 2 3 3 1 2 2 2 1 2 3 1 2 2 2 1 3 1 1 3 2 2 2
##  [667] 1 2 1 2 2 2 1 1 2 2 2 2 2 2 1 2 2 1 1 2 2 2 1 3 2 1 1 2 1 1 1 3 3 3 3 3 3
##  [704] 3 3 3 3 3 2 1 2 1 1 1 1 1 1 1 2 2 2 2 3 3 2 2 2 1 1 2 2 2 2 1 2 2 2 2 2 2
##  [741] 2 1 2 3 1 1 3 2 1 1 1 3 1 1 3 2 3 3 3 1 3 1 3 3 2 3 2 3 3 3 1 1 1 1 1 1 3
##  [778] 3 3 3 1 3 3 3 1 1 3 1 1 3 1 3 1 1 1 2 3 3 3 3 1 3 1 3 1 1 3 2 2 1 1 2 2 1 3
##  [815] 2 1 3 3 2 1 1 3 1 1 1 3 1 3 1 1 2 1 2 1 3 1 1 3 1 3 3 3 3 3 3 3 3 3 3 3 3
##  [852] 3 2 1 3 3 1 3 3 3 3 3 3 1 3 3 1 3 1 3 1 3 1 1 1 1 3 3 3 1 3 1 1 3 3 3 3 1
##  [889] 3 3 1 1 3 2 1 1 1 1 2 1 3 2 1 1 3 2 1 1 2 1 2 1 3 3 3 1 1 3 1 1 1 1 1 2 2
##  [926] 1 1 1 1 1 1 3 3 3 1 1 1 1 1 3 2 2 2 1 1 1 3 3 1 2 2 2 1 3 3 1 1 1 2 1 1 1
##  [963] 1 3 3 2 1 1 1 3 1 1 2 1 2 1 2 2 3 1 3 3 1 3 3 3 3 3 3 3 3 1 1 1 2 3 1 1 3 3
## [1000] 3 3 3 3 3 3 3 3 3 2 2 1 1 2 2 1 1 2 1 1 2 2 2 2 2 2 1 1 2 2 2 2 1 2 1 2 2
## [1037] 1 3 2 2 3 1 1 1 2 1 2 1 1 2 1 2 2 1 2 1 1 3 2 2 2 2 1 2 1 1 2 2 1 1 1 1 1
## [1074] 3 1 1 1 1 1 1 1 1 1 2 1 3 1 1 1 1 3 3 3 3 3 1 3 3 3 3 3 3 3 3 3 3 3 3 3 3
## [1111] 3 2 1 2 2 1 2 2 3 2 2 1 2 3 1 1 1 1 3 1 1 1 3 2 3 2 1 3 2 3 1 1 1 2 3 1 1
## [1148] 3 3 1 1 1 1 3 3 3 1 3 1 3 1 1 3 3 1 1 1 3 2 1 1 1 1 3 1 1 1 3 1 1 1 3 1 1
## [1185] 1 1 1 1 3 1 1 1 1 2 2 3 3 2 1 1 1 2 2 1 3 1 2 1 3 1 1 2 1 2 1 3 1 1 2 2 1
## [1222] 1 1 1 2 2 1 1 2 2 1 3 1 1 1 2 1 1 1 3 1 2 2 1 3 3 1 3 1 1 3 3 3 3 3 3 3 3
## [1259] 3 3 1 1 2 3 3 1 3 3 3 3 3 3 1 1 2 3 3 3 3 2 3 2 2 3 1 1 1 1 1 1 2 3 3 2 3
## [1296] 3 3 3 3 1 2 1 2 1 1 2 3 1 2 2 2 3 3 1 2 1 1 1 2 3 2 2 2 2 2 1 2 2 1 1 2 1
## [1333] 3 3 2 1 1 1 2 1 2 3 2 1 1 2 2 3 1 3 1 1 2 2 2 1 1 2 1 3 2 1 1 1 1 1 1 1 1
## [1370] 1 1 1 1 1 2 1 2 1 1 1 2 1 2 2 2 2 2 1 1 2 2 2 2 2 2 1 2 1 1 1 1 2 2 2 3 3
## [1407] 2 2 2 2 3 1 1 3 1 1 1 3 2 3 1 1 1 1 1 1 2 1 1 3 1 1 2 3 1 2 1 1 1 1 3 3 1
## [1444] 2 2 1 1 1 1 1 1 1 1 1 1 3 2 3 1 1 3 2 1 1 3 1 1 1 1 3 1 3 1 1 1 3 3 1 1 2
## [1481] 3 1 1 1 1 1 1 1 1 3 2 2 1 2 3 3 1 2 2 3 1 3 3 3 1 3 1 3 1 3 3 3 1 3 3 3 1 1
## [1518] 3 1 3 3 3 1 1 1 3 1 1 3 1 3 3 3 3 3 3 3 2 1 3 3 1 3 3 2 3 1 1 3 1 2 1 1 1
## [1555] 3 3 3 3 3 3 1 1 3 2 3 3 3 1 3 1 1 3 2 3 2 3 1 3 1 3 3 3 3 1 3 3 1 3 3 3 1 1
```

```
## [1592] 1 3 3 1 2 1 2 3 1 2 2 2 2 1 1 2 2 2 3 1 1 1 3 2 1 1 1 2 2 1 1 3 3 1 1 2 2
## [1629] 1 2 2 1 1 2 2 1 3 1 2 2 3 3 3 3 3 3 3 3 1 2 3 3 1 3 3 1 3 3 2 3 3 3 3 3 1
## [1666] 3 3 2 2 3 3 3 1 3 2 1 1 1 3 1 2 2 3 1 1 3 3 1 1 3 1 3 1 1 3 1 1 3 1 3 1 1
## [1703] 1 2 1 2 2 3 1 1 1 2 1 2 3 2 1 1 2 2 2 1 1 1 1 1 1 1 1 1 1 1 3 3 3 3 1 3
## [1740] 3 3 3 3 3 3 3 3 3 1 3 3 3 3 1 1 1 1 1 1 2 1 1 3 3 3 3 3 3 3 3 3 3 3 3 3 3
## [1777] 3 3 3 1 1 3 3 3 3 3 3 3 3 3 1 1 3 3 3 3 3 3 3 3 3 3 3 1 2 3 3 1 3 3 3 3 3 3 3
## [1814] 3 3 3 3 3 3 3 1 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 1 3 3 3 3 3 3 3 3 3 3
## [1851] 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 1 1 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3
## [1888] 3 3 3 3 3 3 1 3 3 3 3 3 3 3 3 3 3 3 3 1 1 3 1 1 1 1 3 1 1 3 1 1 1 3 3 3 3 3 3
## [1925] 3 3 2 3 3 3 3 3 3 3 3 1 3 3 3 3 3 3 3 3 1 3 3 3 3 3 3 3 3 3 3 1 3 3 1 3 3 3 3 3 3 3
## [1962] 1 1 3 1 3 3 3 3 3 3 1 3 3 3 1 3 3 3 3 3 3 1 3 3 3 3 1 3 3 3 1 3 1 3 3 1 3 3
## [1999] 3 1 1 1 2 1 3 3 3 3 1 1 3 3 3 3 1 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 1 3 3 3
## [2036] 1 3 3 3 1 3 3 1 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 1 3 3 3 3 3 3
## [2073] 3 3 3 3 3 3 1 3 3 3 3 3 3 3 3 1 3 3 3 3 3 1 3 3 3 3 3 3 3 3 3 3 2 1 3 3
## [2110] 3 3 3 1 3 3 3 3 3 3 3 3 3 1 3 3 1 1 3 1 3 3 3 3 3 3 3 3 3 3 3 2 3 3 3 3 3
## [2147] 3 3 1 3 3 3 3 3 3 3 3 3 3 1 1 1 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3
## [2184] 3 3 1 1 3 3 3 2 3 3 3 3 2 3 3 3 3 3 3 3 3 3 3 3 2 3 3 3 3 3 1 3 3 3 3 3
## [2221] 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 1 3 3 3 3 1 3 3 3 3 1 3 3 3 3 1 3 3 3 2
## [2258] 3 3 1 1 3 3 3 3 3 3 3 3 3 3 3 3 3 1 3 1 3 3 3 3 3 3 3 2 3 3 3 1 3 3 3 3 3 1
## [2295] 2 3 3 3 3 3 3 3 3 3 3 3 3 3 3 1 3 3 3 3 1 3 3 3 1 3 1 2 1 1 1 3 3 3 1 3 1 1
## [2332] 1 3 3 3 3 3 3 3 3 3 3 3 3 3 3 1 3 3 1 3 3 3 3 3 3 3 1 3 3 3 3 3 3 1 3 3 2 3
## [2369] 1 3 3 3 3 3 3 3 3 1 3 3 3 3 3 3 3 3 3 3 1 3 3 3 3 3 3 3 3 1 3 3 1 3 3 3 3 3 3
## [2406] 1 3 1 3 3 3 3 3 3 3 3 3 1 1 3 3 3 3 3 3 3 1 3 3 3 3 1 3 3 3 3 3 3 3 1 3 1 1 3 3
## [2443] 3 3 3 3 3 3 2 3 3 1 3 3 3 3 3 3 3 3 3 3 1 3 2 3 3 3 3 3 3 3 1 3 3 3 1 3 3 3 3 3
## [2480] 3 3 3 3 3 3 3 3 3 3 3 3 1 3 3 3 3 3 3 1 3 3 3 3 3 3 3 3 3 3 3 3 1 1 3 3 3 3 3 3 3 1
## [2517] 3 1 3 3 3 3 3 3 3 3 3 3 1 3 3 3 3 3 3 1 3 3 3 1 3 3 3 3 3 3 3 3 1 3 3 3 3 3 3 3
## [2554] 1 3 3 3 3 1 3 3 1 3 3 3 3 3 3 3 3 3 3 3 1 3 3 2 3 3 3 3 3 3 3 3 3 3 3 3 3 3 1
## [2591] 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 1 3 1 3 3 3 3 3 3 3 3 3 3 3 1 3 3 3
## [2628] 3 3 3 3 3 1 3 3 3 3 3 3 3 2 2 3 3 3 1 3 3 3 3 1 3 3 3 1 3 3 3 3 3 3 3 3 1 3 2 3
## [2665] 3 3 3 3 3 3 3 3 1 3 3 3 3 3 3 1 3 3 3 3 1 3 3 3 3 3 1 3 3 3 1 3 3 1 3 3 3 3
## [2702] 3 3 3 3 3 1 3 1 3 3 3 3 3 3 3 3 3 3 3 3 3 2 3 3 3 3 3 3 3 3 3 3 3 1 3 3 3 3 3 3
## [2739] 1 3 3 3 3 3 3 1 3
##
## Within cluster sum of squares by cluster:
## [1] 220860130863 168599298773 205737186965
##  (between_SS / total_SS =  77.7 %)
##
## Available components:
##
## [1] "cluster"      "centers"      "totss"        "withinss"     "tot.withinss"
## [6] "betweenss"    "size"         "iter"         "ifault"
```

Code



Revenue & Expenses

The following graph shows the breakdown of revenues and expenses per full-time student based on college type. Here, non-profit private colleges collect the most revenue compared to public universities or proprietary (for-profit) colleges. However, proprietary colleges have less expenses per student by comparison. Private colleges appear to have the highest expenses. In the case of public colleges, on average, the expenses are exceeding revenue; these colleges are supported by state taxpayer funding. By zip code, the locations with higher costs of attendance (as displayed previously) have higher revenues.

Top 5 Revenues per Full-time Student:

Code

```
##                    Name State        SchoolType RevenueFT
## 114       Pitzer College    CA Private-Nonprofit     52786
## 623        Bates College    ME Private-Nonprofit     47882
## 1010 Colgate University    NY Private-Nonprofit     45259
## 1601 Middlebury College    VT Private-Nonprofit     45001
## 2464   Landmark College    VT Private-Nonprofit     44028
```

Bottom 5 Revenues per Full-time Student:

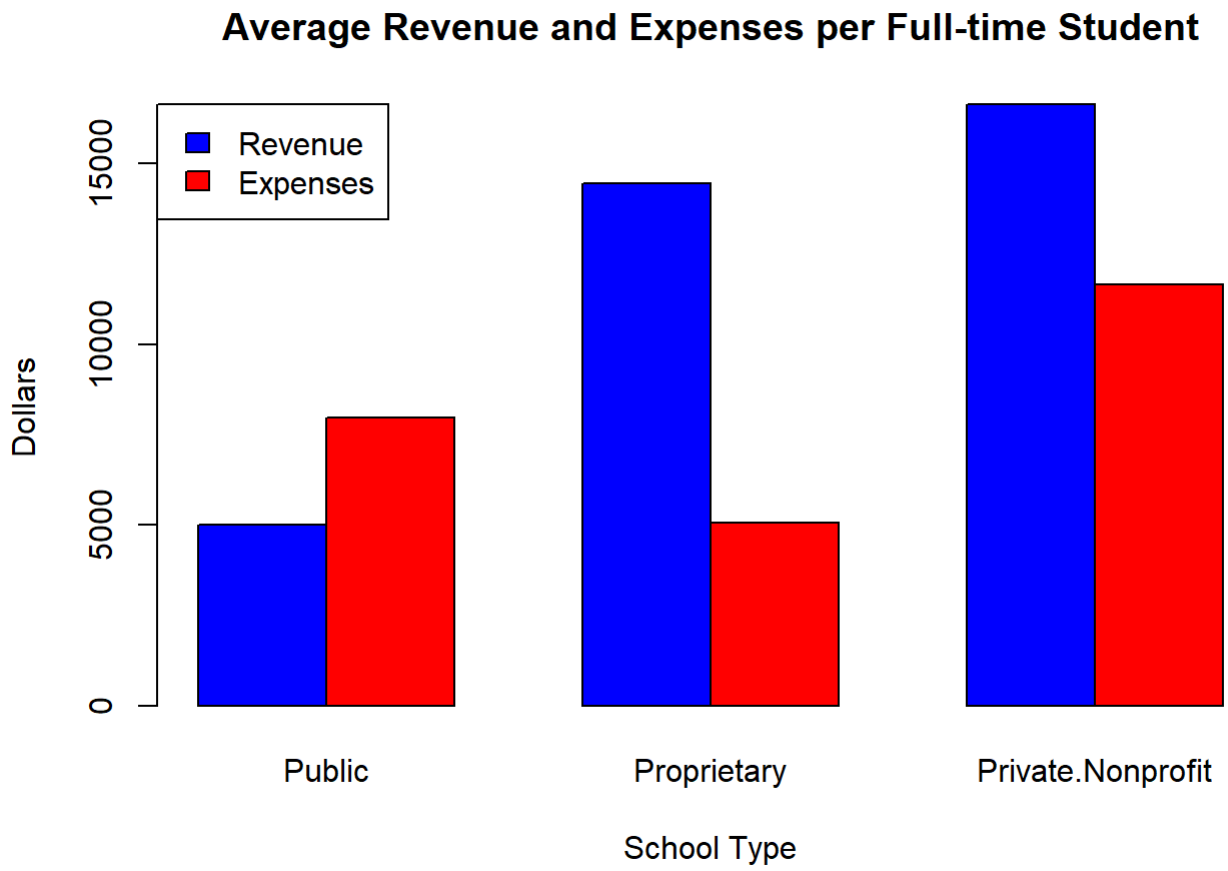
Code

```
##                                         Name State        SchoolType
## 388  City Colleges of Chicago-Malcolm X College    IL            Public
## 2596          Copper Mountain Community College    CA            Public
## 2272         American University of Puerto Rico    PR Private-Nonprofit
## 1121                             Webb Institute    NY Private-Nonprofit
## 1116      United States Merchant Marine Academy    NY            Public
##      RevenueFT
## 388        315
## 2596       215
## 2272        92
## 1121        55
## 1116         0
```

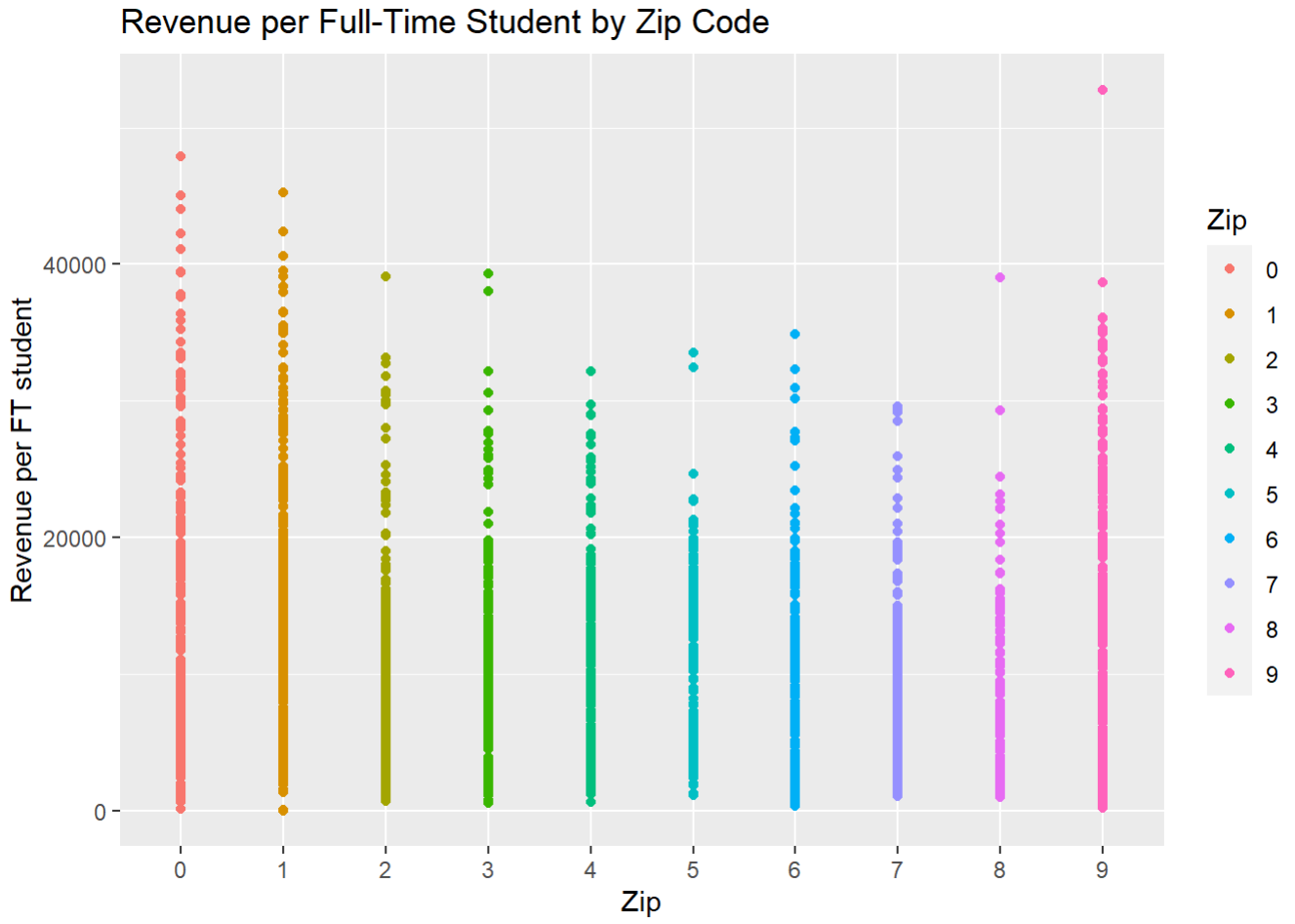
Code

```
## [1]  5012.833 14463.627 16648.148
```

Code

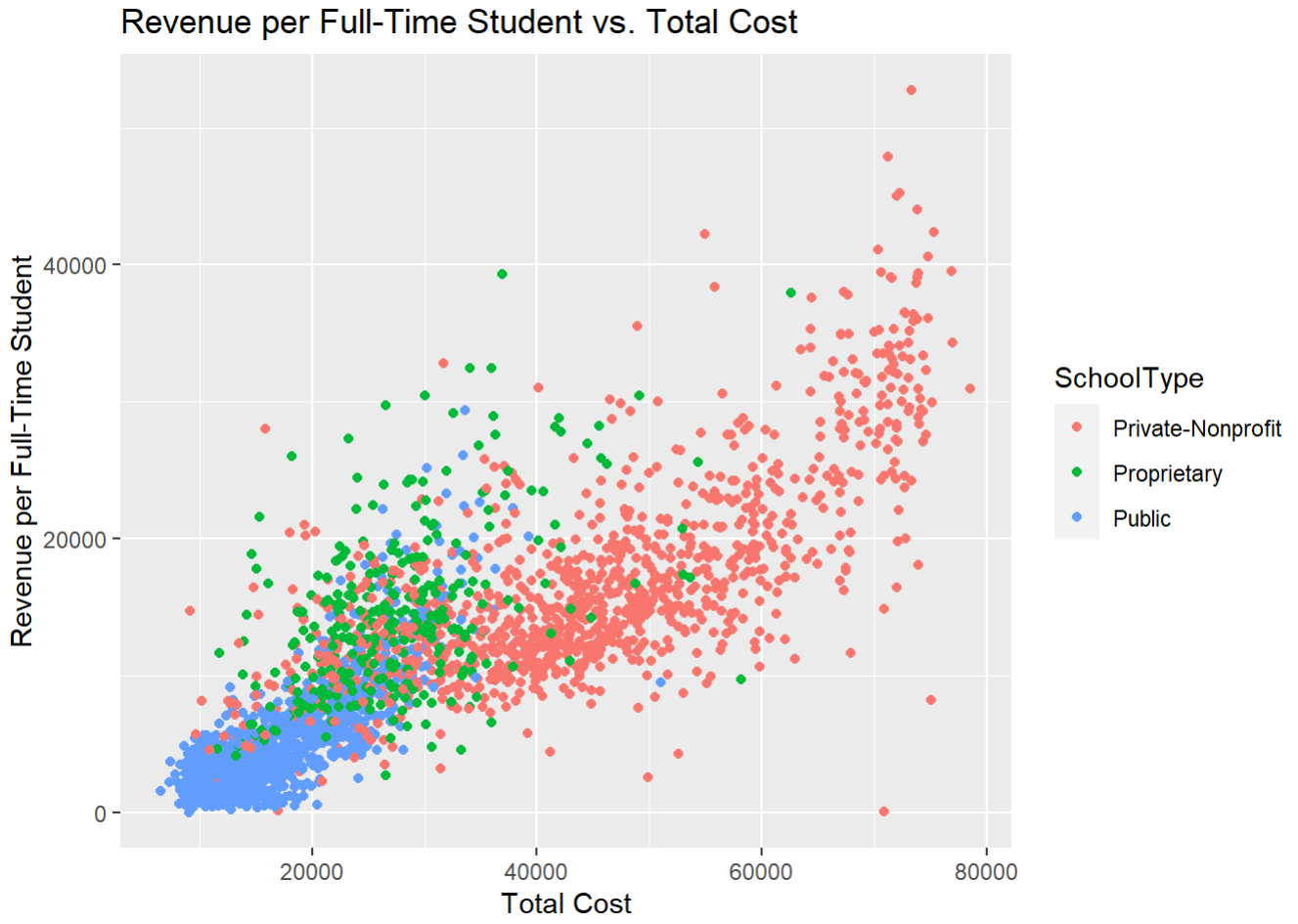


Code



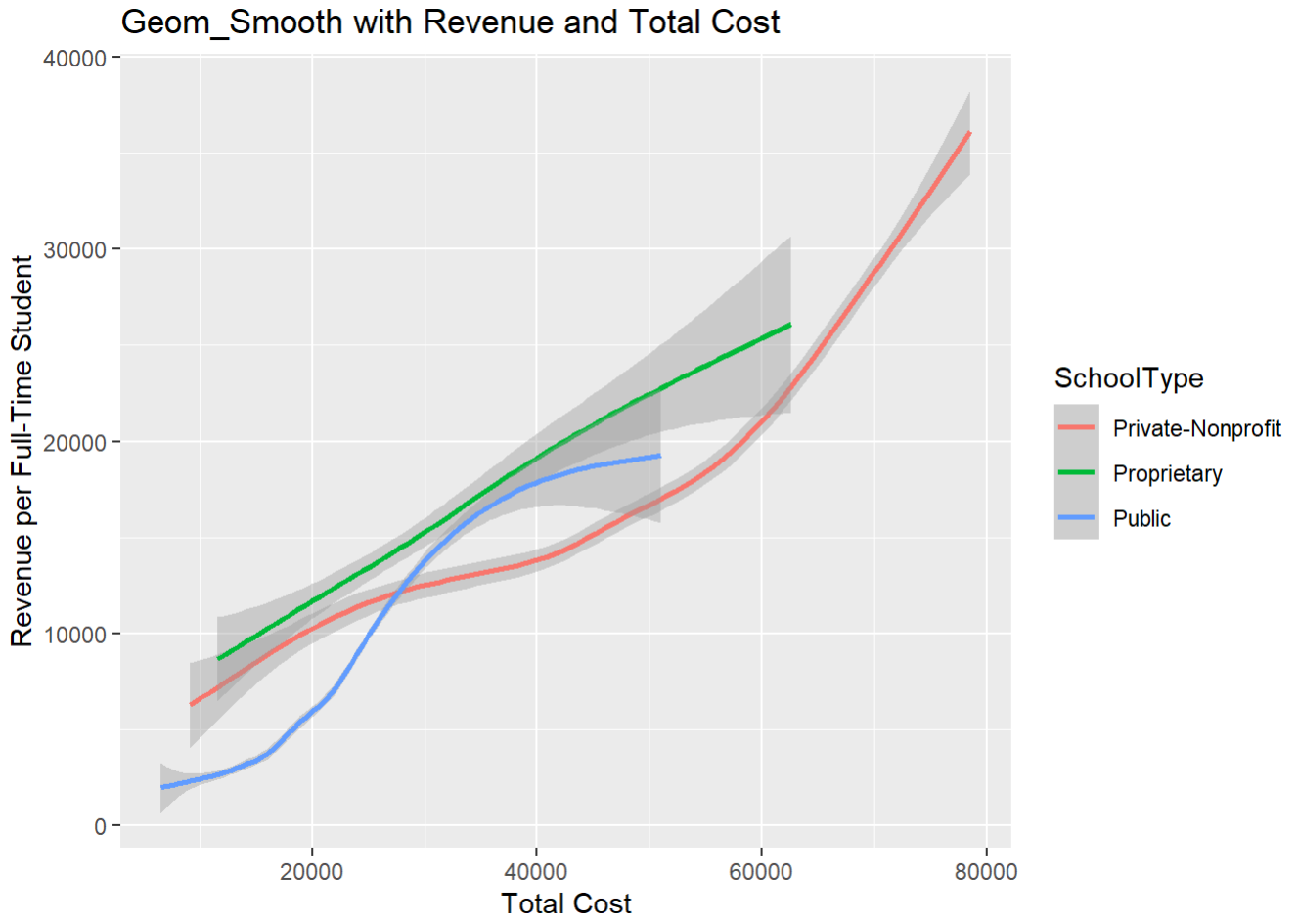
The following graph illustrates the increase of revenue as related to an increase in cost of attendance. In the geom_smooth model, public colleges follow a logistic S-shape curve whereas private colleges follow more of an exponential incline. Proprietary colleges achieve a linear pattern between revenue and cost.

Code



Code

```
## `geom_smooth()` using method = 'gam' and formula 'y ~ s(x, bs = "cs")'
```



Faculty Salaries

In examining the average monthly faculty salary, the visualization below presents salary versus the revenue per full-time student. The black line indicates the average of all salaries in the dataset. Proprietary colleges seem to maintain lower monthly salaries (below the average salary) despite more revenue.

In the zip code analysis, the West, New England, and the greater NY region maintain some of the highest salaries. Region 5 (comprised of Iowa, Minnesota, Montana, North Dakota, South Dakota, Wisconsin) has a shorter range of salaries.

Top 5 Salaries:

Code

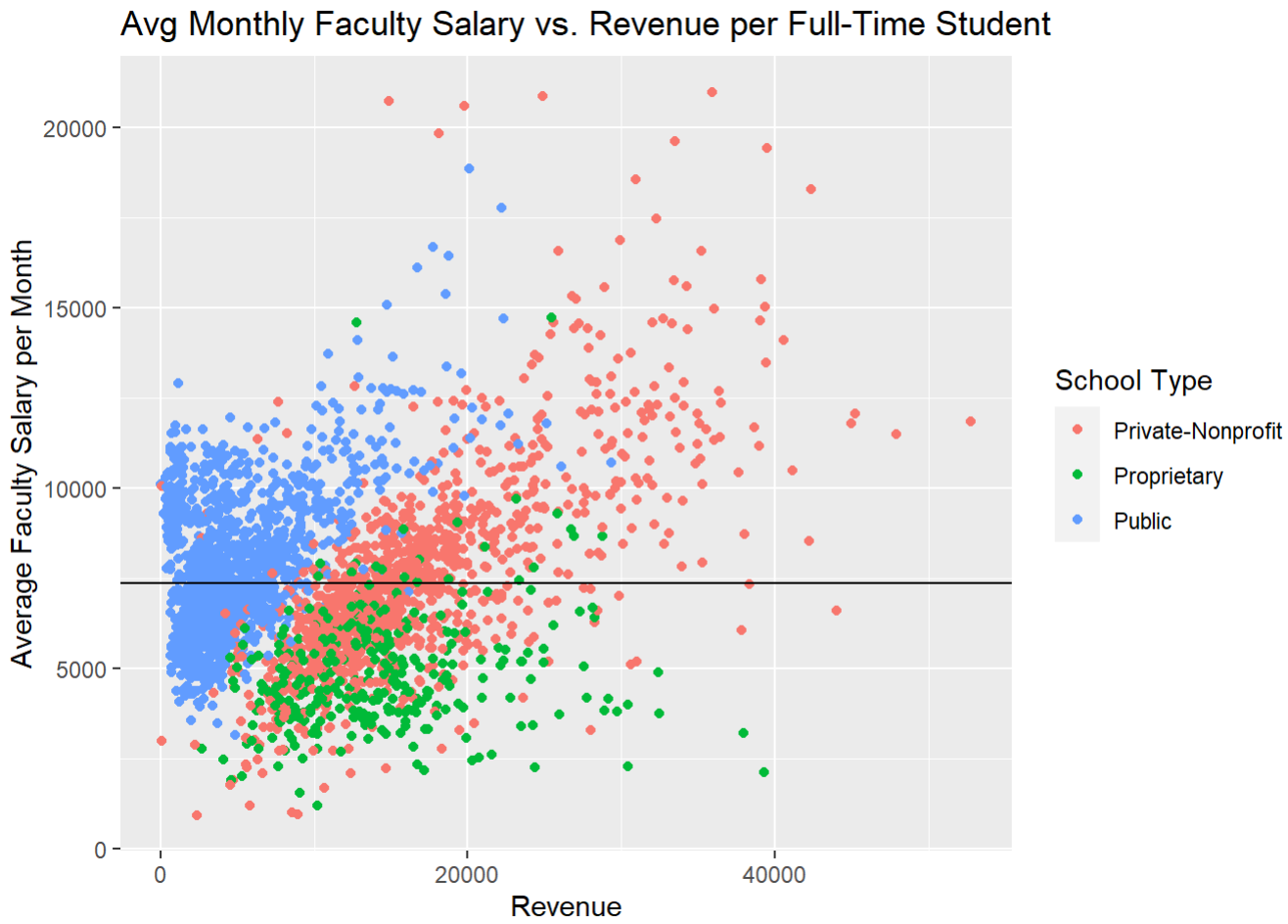
```
##                                 Name State        SchoolType SalaryAVG
## 693                 Harvard University    MA Private-Nonprofit     20988
## 190                Stanford University    CA Private-Nonprofit     20865
## 972              Princeton University    NJ Private-Nonprofit     20724
## 85  California Institute of Technology    CA Private-Nonprofit     20595
## 254                    Yale University    CT Private-Nonprofit     19830
```

Bottom 5 Salaries:

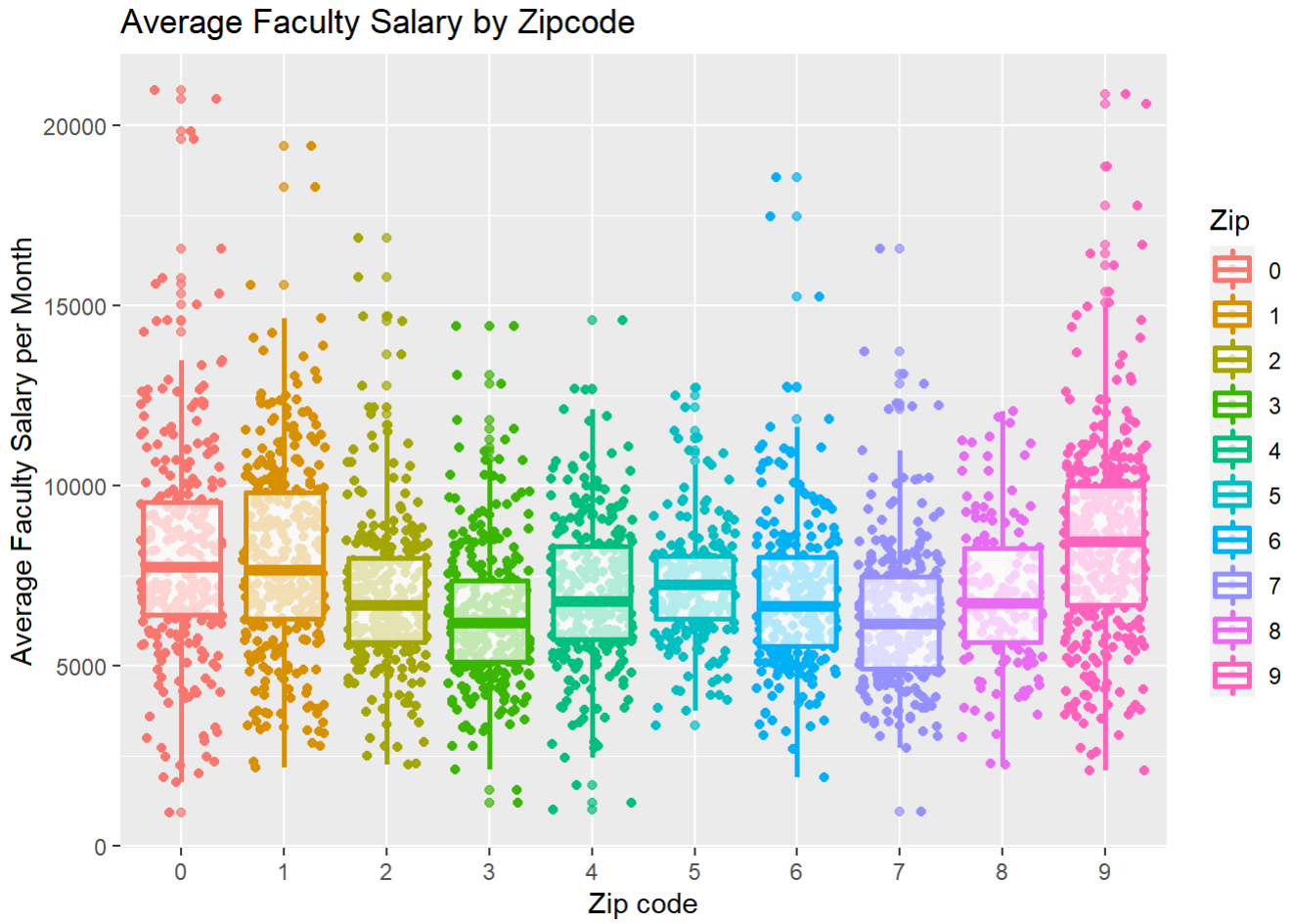
Code

```
##                                     Name State        SchoolType SalaryAVG
## 2405         Gods Bible School and College    OH Private-Nonprofit      1198
## 2617 Advance Science International College    FL       Proprietary      1194
## 2491       Kentucky Mountain Bible College    KY Private-Nonprofit      1002
## 2630                       Ecclesia College    AR Private-Nonprofit       963
## 2442      Universidad Teologica del Caribe    PR Private-Nonprofit       940
```

Code



Code



Student Loan Debt

In analyzing loan debt, the first graph shows college default rate versus average family income. There appears to be a visible relationship between these two criteria; as family income increases, the default rate decreases. The next histograms show the distribution of default rate by school type and then by location. There is a higher concentration of private colleges with lower default rates. The violin graph creates a visualization of the density of median loan debts. In this example, proprietary and public institutions share a similar shape whereas private colleges have a higher median loan debt concentration.

Top 5 Default Rates:

Code

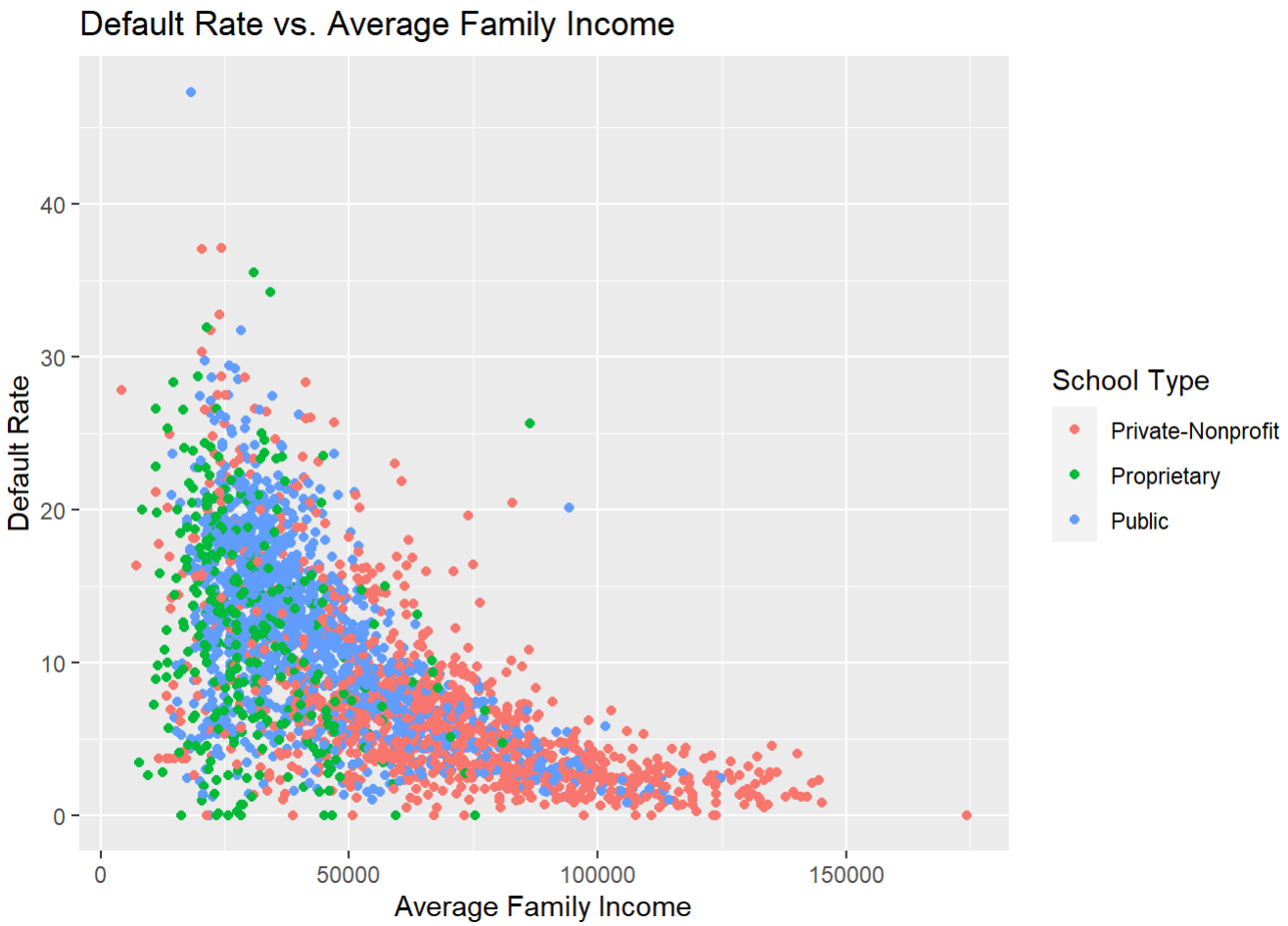
```
##                           Name State        SchoolType DefaultRatePercent
## 1873  Denmark Technical College    SC            Public               47.3
## 1826            Clinton College    SC Private-Nonprofit               37.1
## 55     Arkansas Baptist College    AR Private-Nonprofit               37.0
## 2682 MediaTech Institute-Dallas    TX       Proprietary               35.5
## 2740   Sonoran Desert Institute    AZ       Proprietary               34.2
```

Top 5 Outstanding Loan Totals:

Code

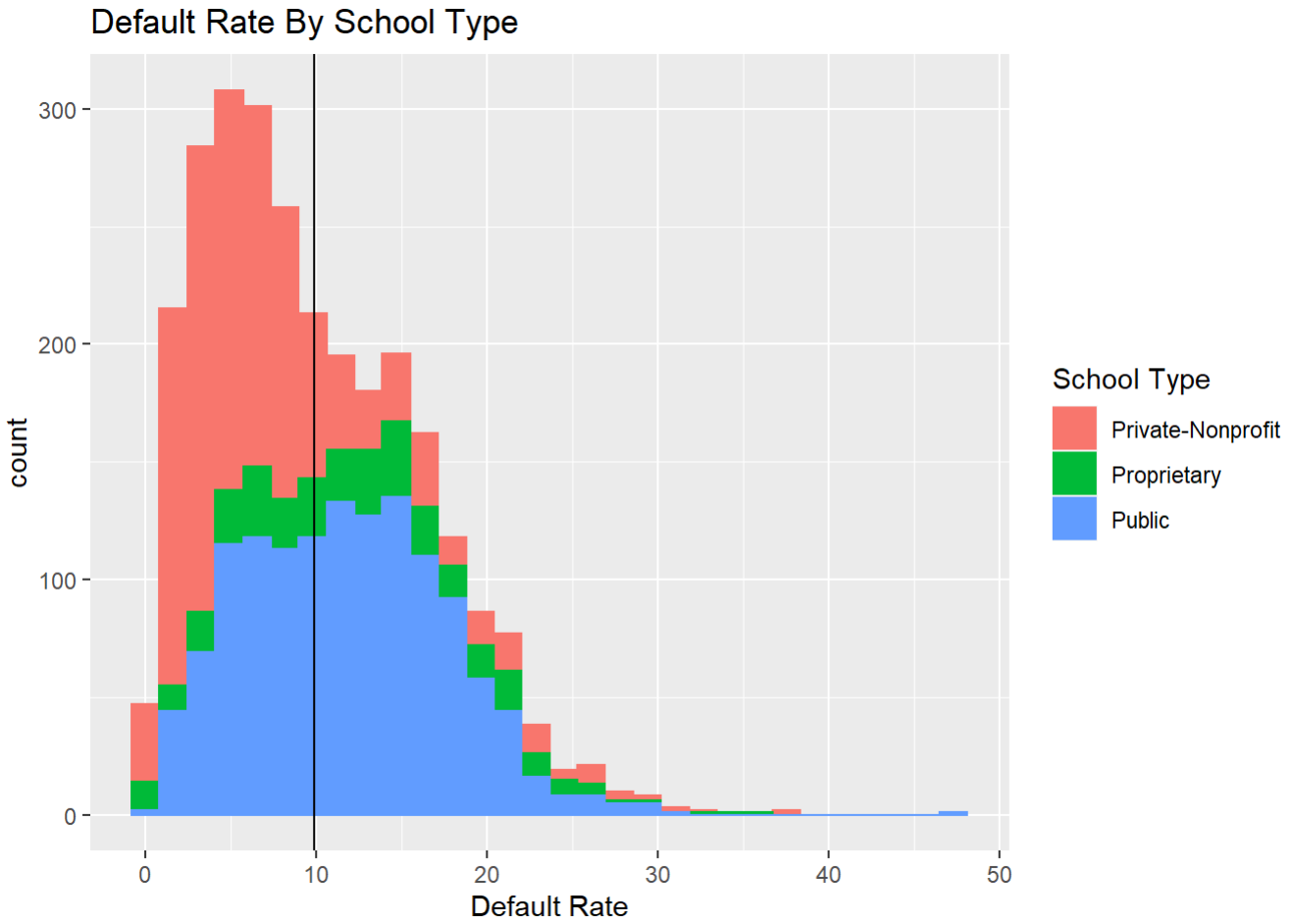
```
##                                 Name State        SchoolType   LoanTotal
## 2341    University of Phoenix-Arizona    AZ       Proprietary 37427769280
## 2229        DeVry University-Illinois    IL       Proprietary 12690573163
## 267  Strayer University-Global Region    DC       Proprietary  9401828507
## 45             Grand Canyon University    AZ       Proprietary  8270808321
## 297      Nova Southeastern University    FL Private-Nonprofit  8216982781
```

Code

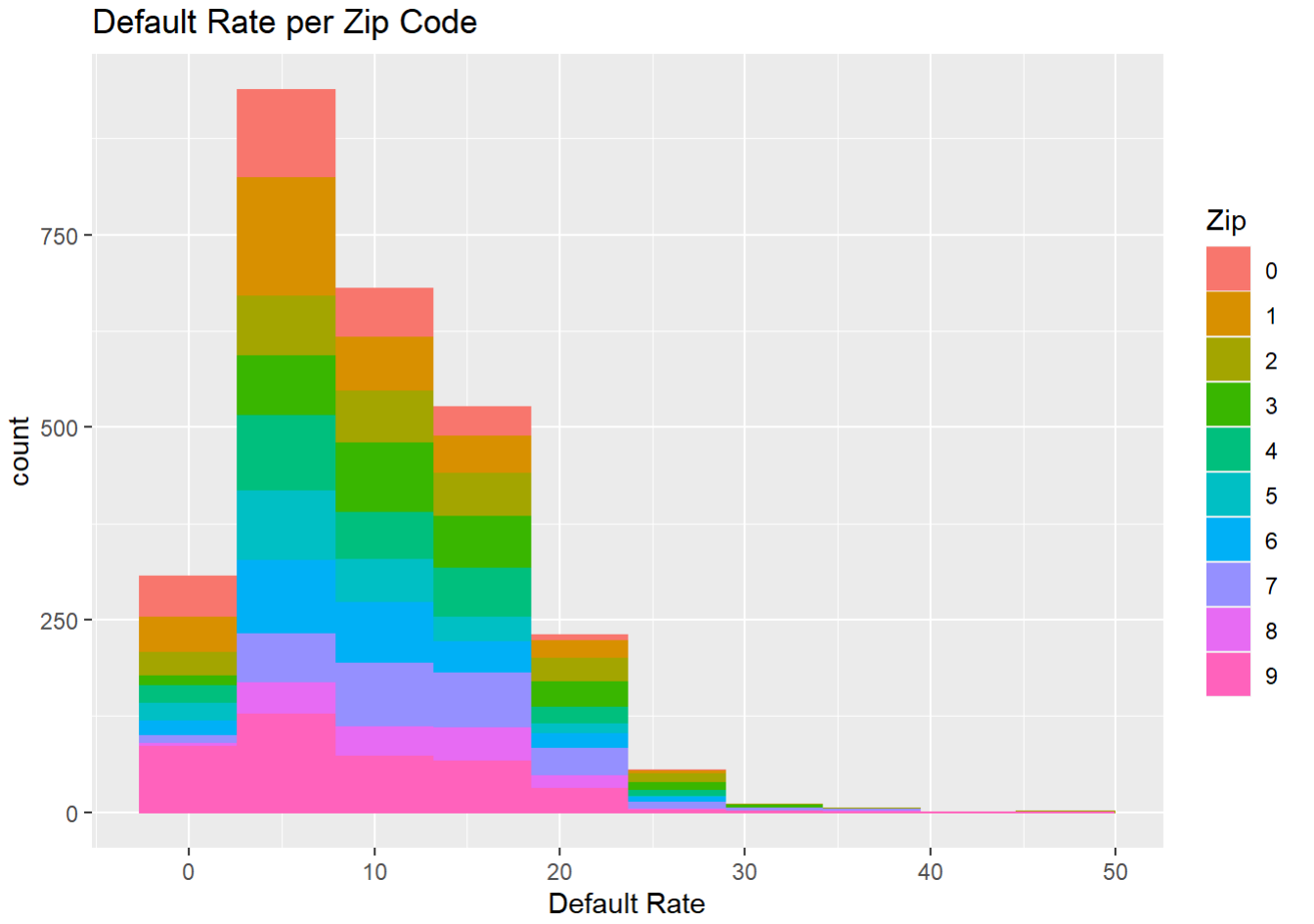


Code

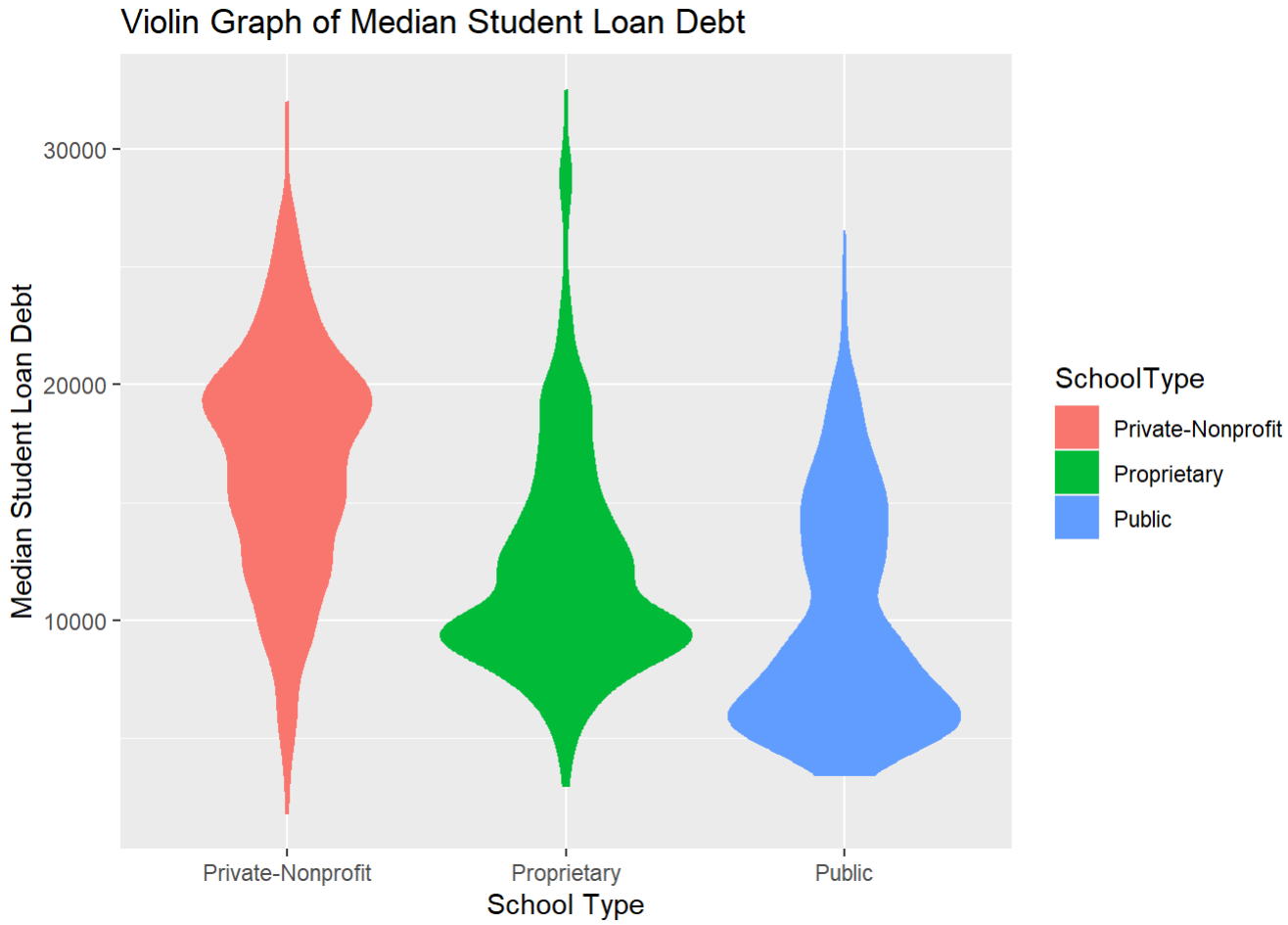
```
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```


Default Rate By School Type
300
200
100
0
count
0
10
20
30
40
50
Default Rate
School Type
Private-Nonprofit
Proprietary
Public

Code


Default Rate per Zip Code
count
750
500
250
0
0
10
20
30
40
50
Default Rate
Zip
0
1
2
3
4
5
6
7
8
9

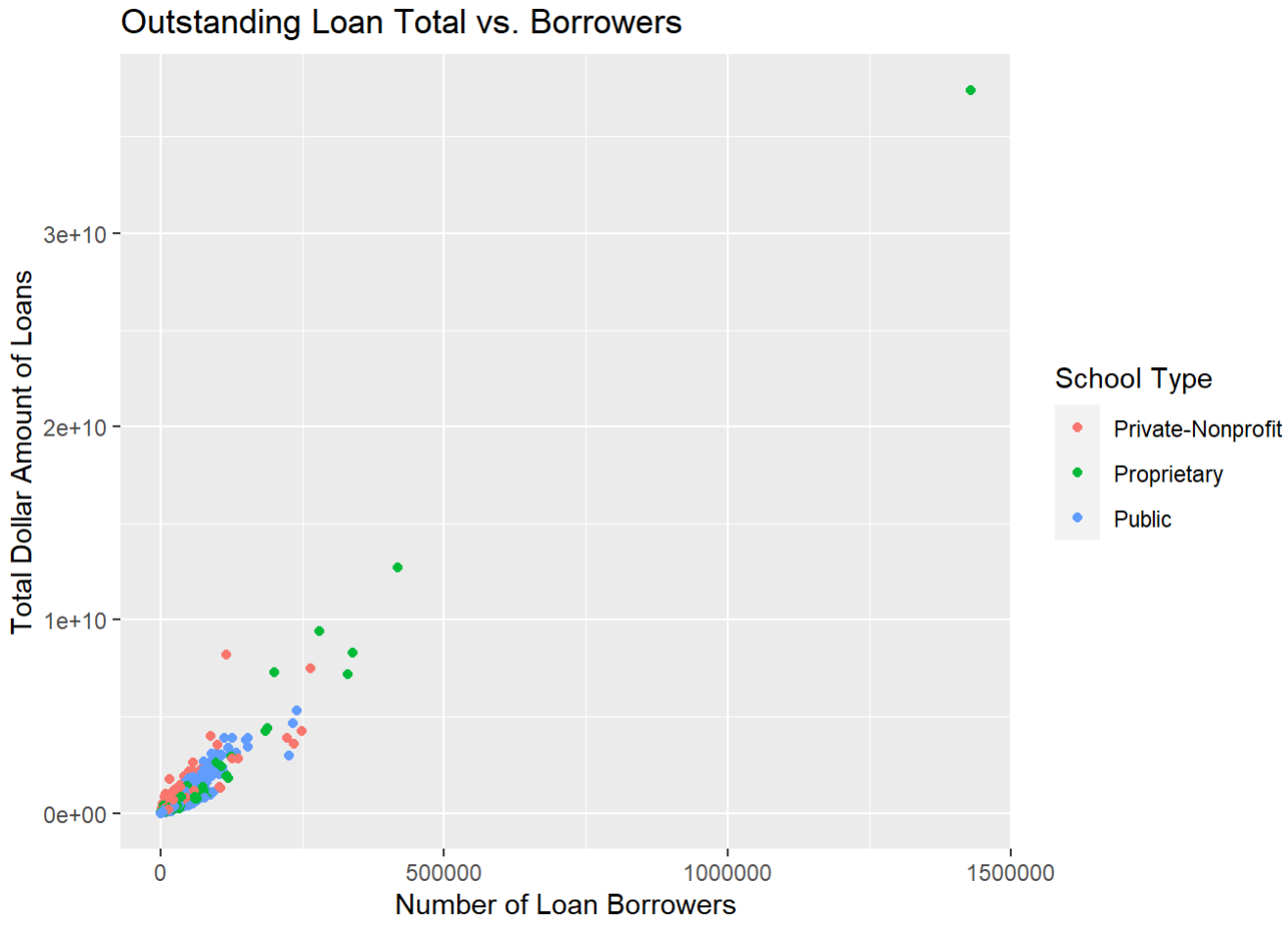
Code



Regression Example

In the example below, there is a strong linear relationship between the total dollar amount of federal student loans with outstanding balances compared to the number of loan borrowers with outstanding balances (ED, 2021). While the graph shows a major outlier (University of Phoenix), this outlier seemingly aligns with the regression example. The regression line can also be seen in a “zoomed in” example. In the regression formula, the multiple R-squared in this case is 93.89% (good confidence) and, because p is less than .05, the Null hypothesis is rejected; the number of borrowers with outstanding balances does impact the total dollar amount of outstanding debt.

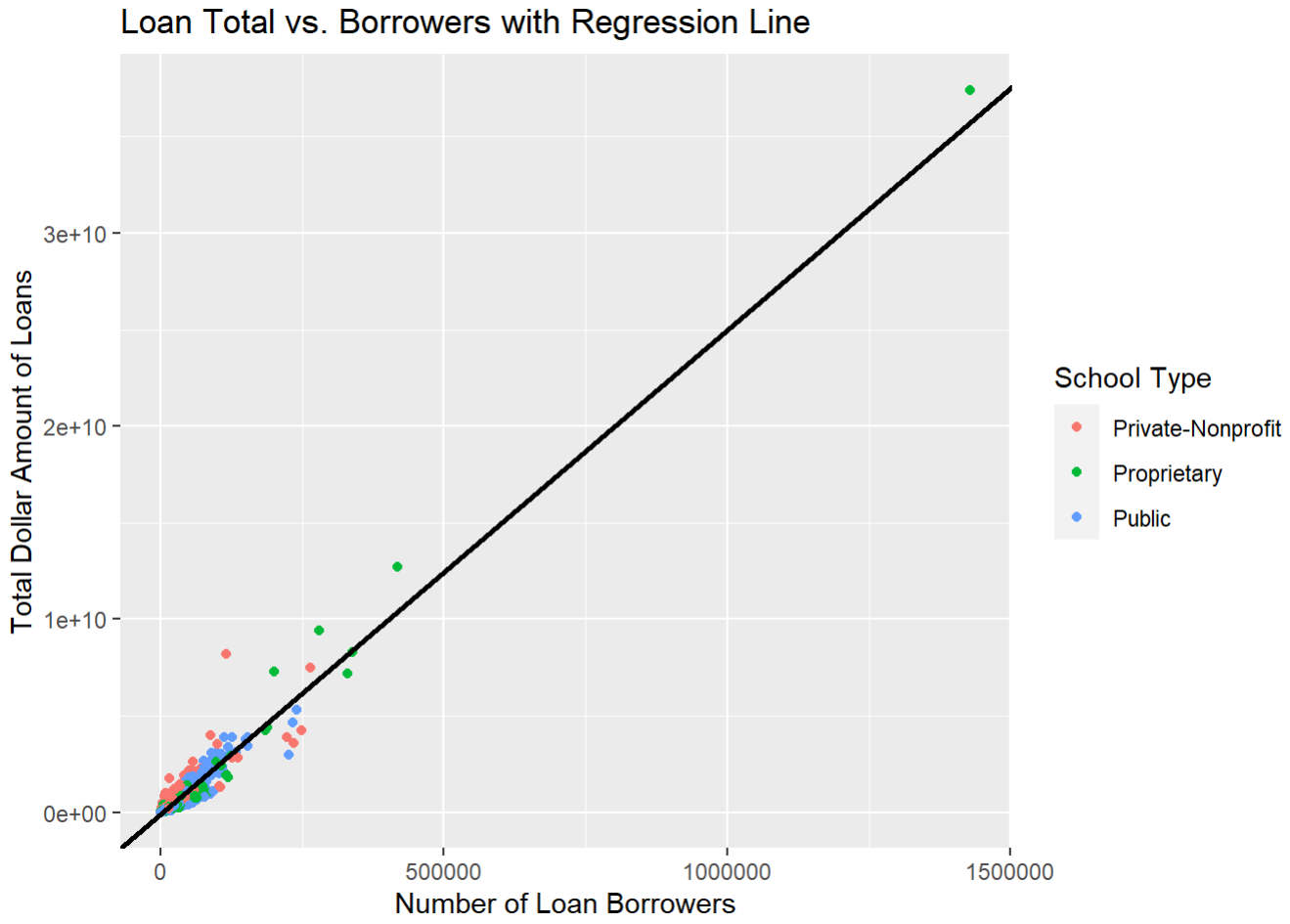
Code



Code

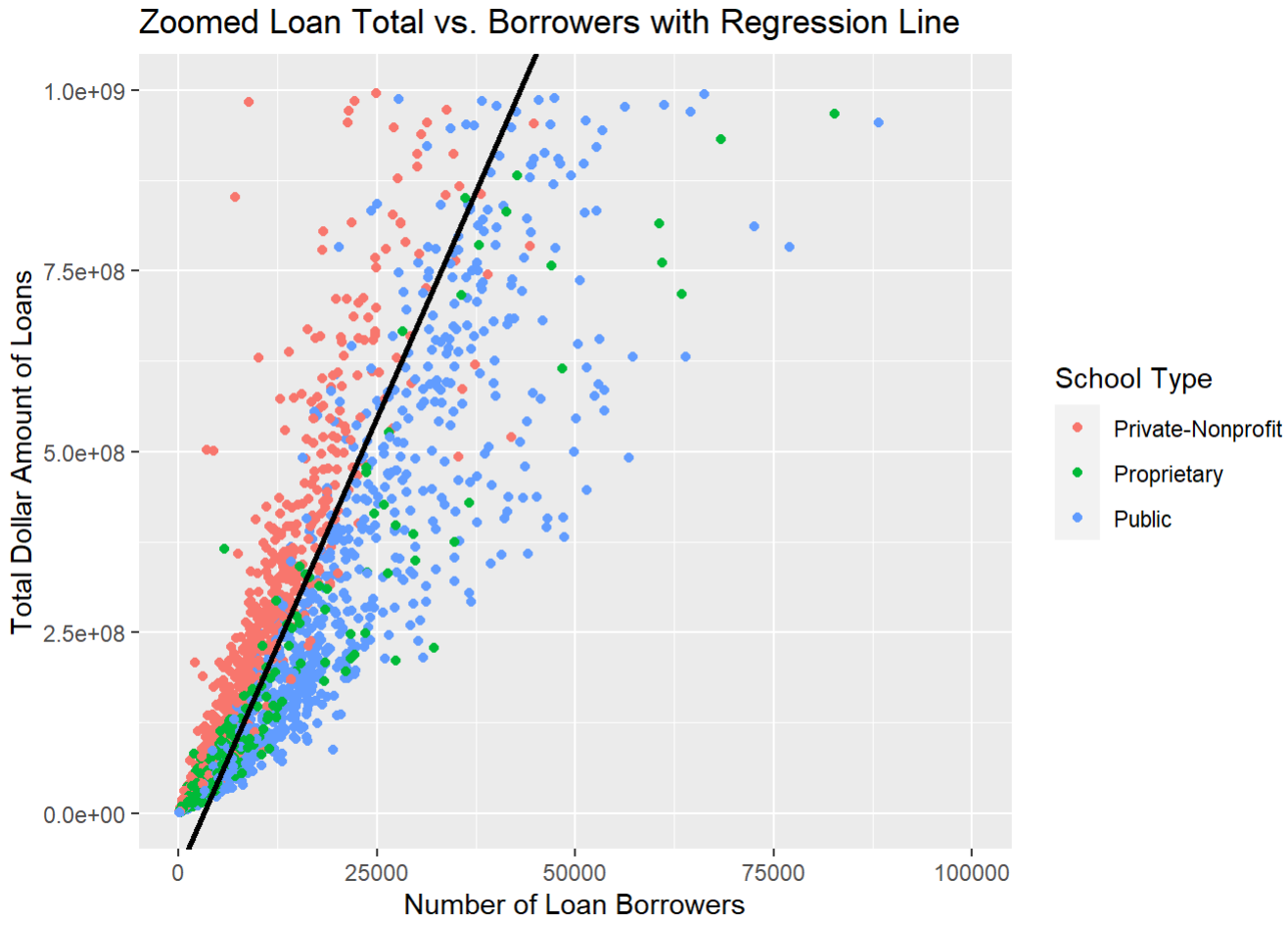
```
##
## Call:
## lm(formula = coldata$LoanTotal ~ coldata$LoanCount)
##
## Coefficients:
##       (Intercept)  coldata$LoanCount
##         -78574048              25091
```

Code



Code

```
## Warning: Removed 231 rows containing missing values (geom_point).
```



Code

```
##
## Call:
## lm(formula = coldata$LoanTotal ~ coldata$LoanCount)
##
## Residuals:
##        Min         1Q     Median         3Q        Max
## -2.639e+09 -4.552e+07  2.685e+07  5.936e+07  5.402e+09
##
## Coefficients:
##                      Estimate Std. Error t value Pr(>|t|)
## (Intercept)       -7.857e+07  5.117e+06  -15.36   <2e-16 ***
## coldata$LoanCount  2.509e+04  1.222e+02  205.36   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 243500000 on 2744 degrees of freedom
## Multiple R-squared:  0.9389, Adjusted R-squared:  0.9389
## F-statistic: 4.217e+04 on 1 and 2744 DF,  p-value: < 2.2e-16
```

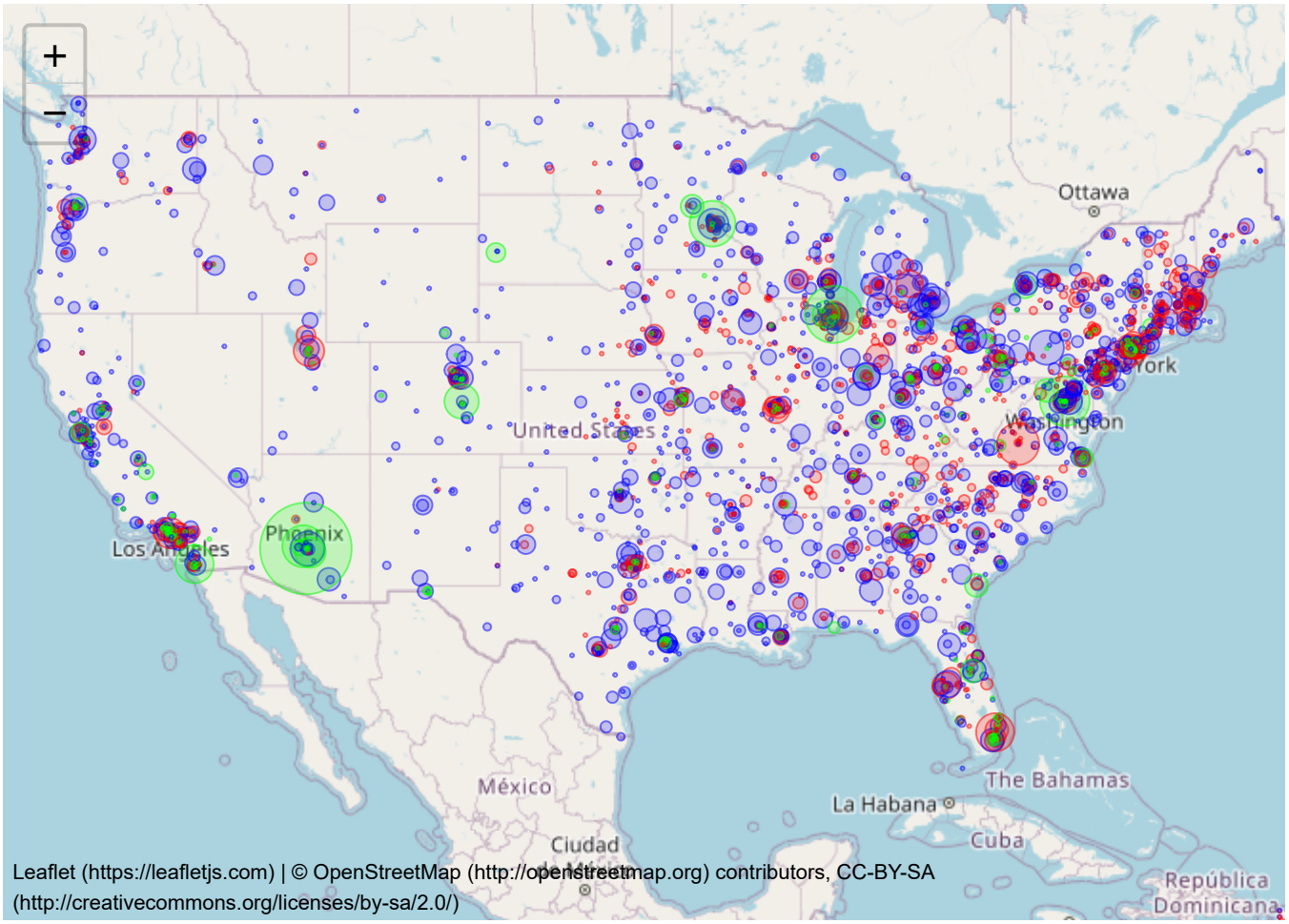
Map with Loan Data

In this final example, the loan and geographic information from the Scorecard dataset are combined using the leaflet library. This graphic shows a U.S. map with interactive zoom. The colors are indicative of the school type, keeping the same pattern as prior–blue (public), green (proprietary), red (private-nonprofit). Additionally, the circles indicate both the location of the school as well as the total outstanding student loans owed from borrowers at that institution. This visualization provides a deeper understanding of outstanding loan debt in the United States in terms of both location and school type.

Code

```
## Warning: package 'leaflet' was built under R version 4.1.2
```

Code



Conclusion

The College Scorecard operates as a consumer guide for prospective students to obtain a data-informed snapshot of a college/university. Through data analytics on this dataset, one can see patterns in the higher education industry as a whole. These visualizations represent examples of how money shapes the higher education landscape. One can see the impact of radical outliers in comparison to the majority of institutions. The outstanding loan totals point to a seeming monopolization of the industry and a major problem in terms of education-related loan debt. Review of this data from a “big data” perspective may ultimately drive strategies for more regulatory oversight as well as solutions for growing issues related to student loan borrowing.

References

Federal Student Aid. (2021). AY 2020-2021 Q4. *Title IV Program Volume Reports*. Retrieved November 17, 2021 from https://studentaid.gov/data-center/student/title-iv (https://studentaid.gov/data-center/student/title-iv).

Office of Planning, Evaluation and Policy Development. (2020, July 17). Open Data Platform: College Scorecard. Retrieved November 20, 2021 from https://data.ed.gov/dataset/college-scorecard-all-data-files-through-6-2020/resources (https://data.ed.gov/dataset/college-scorecard-all-data-files-through-6-2020/resources)

U.S. Department of Education. (n.d.). College Scorecard. Retrieved November 20, 2021 from https://collegescorecard.ed.gov/ (https://collegescorecard.ed.gov/)

U.S. Department of Education. (2021). *Technical Documentation: College Scorecard Institution-Level Data (Version: July 2021)*. U.S. Department of Education. https://collegescorecard.ed.gov/assets/FullDataDocumentation.pdf (https://collegescorecard.ed.gov/assets/FullDataDocumentation.pdf)

UnitedStatesZipCodes.org. (2021). Zip Code Zones. Retrieved November 20, 2021 from https://www.unitedstateszipcodes.org/ (https://www.unitedstateszipcodes.org/)