Numeric Summaries

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```
library(tidyverse)
```

```
## -- Attaching packages --------------------------------------- tidyverse 1.3.2 --
## v ggplot2 3.3.6      v purrr   0.3.4
## v tibble  3.1.8      v dplyr   1.0.10
## v tidyr   1.2.1      v stringr 1.4.1
## v readr   2.1.2      v forcats 0.5.2
## -- Conflicts ------------------------------------------ tidyverse_conflicts() --
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()    masks stats::lag()
```

```
# IMPORTING DATASETS
tuition_cost <- readr::read_csv('https://raw.githubusercontent.com/rfordatascience/tidytuesday/master/d
```

```
## Rows: 2973 Columns: 10
## -- Column specification --------------------------------------------------------
## Delimiter: ","
## chr (5): name, state, state_code, type, degree_length
## dbl (5): room_and_board, in_state_tuition, in_state_total, out_of_state_tuit...
##
## i Use `spec()` to retrieve the full column specification for this data.
## i Specify the column types or set `show_col_types = FALSE` to quiet this message.
```

```
tc = tuition_cost

tuition_income <- readr::read_csv('https://raw.githubusercontent.com/rfordatascience/tidytuesday/master
```

```
## Rows: 209012 Columns: 7
## -- Column specification --------------------------------------------------------
## Delimiter: ","
## chr (4): name, state, campus, income_lvl
## dbl (3): total_price, year, net_cost
##
## i Use `spec()` to retrieve the full column specification for this data.
## i Specify the column types or set `show_col_types = FALSE` to quiet this message.
```

```
ti = tuition_income

salary_potential <- readr::read_csv('https://raw.githubusercontent.com/rfordatascience/tidytuesday/mast
```

```
## Rows: 935 Columns: 7
## -- Column specification --------------------------------------------------------
## Delimiter: ","
## chr (2): name, state_name
## dbl (5): rank, early_career_pay, mid_career_pay, make_world_better_percent, ...
```

```
##
## i Use `spec()` to retrieve the full column specification for this data.
## i Specify the column types or set `show_col_types = FALSE` to quiet this message.
```

```
sp = salary_potential

historical_tuition <- readr::read_csv('https://raw.githubusercontent.com/rfordatascience/tidytuesday/ma
```

```
## Rows: 270 Columns: 4
## -- Column specification --------------------------------------------------------
## Delimiter: ","
## chr (3): type, year, tuition_type
## dbl (1): tuition_cost
##
## i Use `spec()` to retrieve the full column specification for this data.
## i Specify the column types or set `show_col_types = FALSE` to quiet this message.
```

```
ht = historical_tuition

diversity_school <- readr::read_csv('https://raw.githubusercontent.com/rfordatascience/tidytuesday/mast
```

```
## Rows: 50655 Columns: 5
## -- Column specification --------------------------------------------------------
## Delimiter: ","
## chr (3): name, state, category
## dbl (2): total_enrollment, enrollment
##
## i Use `spec()` to retrieve the full column specification for this data.
## i Specify the column types or set `show_col_types = FALSE` to quiet this message.
```

```
ds = diversity_school
```

```
# Time to explore the data!
table(tc$state,tc$degree_length)
```

```
##
##                 2 Year 4 Year Other
##   Alabama           21     33     0
##   Alaska             1      5     0
##   Arizona           23     11     0
##   Arkansas          24     22     0
##   California       119    135     0
##   Colorado          18     20     0
##   Connecticut       14     22     0
##   Delaware           4      5     0
##   Florida           33     55     0
##   Georgia           29     50     0
##   Hawaii             8      6     0
##   Idaho              4      9     0
##   Illinois          52     73     0
##   Indiana           18     44     0
##   Iowa              18     34     0
##   Kansas            25     27     0
##   Kentucky          15     29     0
##   Louisiana          8     26     0
##   Maine              9     18     0
##   Maryland          16     29     0
```

```
##   Massachusetts      21     72     0
##   Michigan           30     48     0
##   Minnesota          33     38     0
##   Mississippi        15     17     0
##   Missouri           23     50     0
##   Montana            11     11     0
##   Nebraska           10     23     0
##   Nevada              4      6     0
##   New Hampshire       7     14     0
##   New Jersey         21     33     0
##   New Mexico         14     10     0
##   New York           58    163     0
##   North Carolina     59     58     0
##   North Dakota        9      9     0
##   Ohio               47     80     0
##   Oklahoma           15     25     0
##   Oregon             15     25     0
##   Pennsylvania       31    129     0
##   Rhode Island        1     10     0
##   South Carolina     23     34     0
##   South Dakota        5     13     0
##   Tennessee          17     45     0
##   Texas              67     82     1
##   Utah                4     10     0
##   Vermont             3     16     0
##   Virginia           30     49     0
##   Washington         33     27     0
##   West Virginia       9     21     0
##   Wisconsin          31     36     0
##   Wyoming             7      1     0
```

```
bystate = tc %>%
  group_by(state) %>%
  mutate(freq = n()) %>%
  summarize(numSchools = sum(freq)) %>%
  mutate(prop=numSchools/sum(numSchools)) %>%
  arrange(desc(prop))
bystate
```

```
## # A tibble: 51 x 3
##    state          numSchools   prop
##    <chr>               <int>  <dbl>
##  1 California          64516 0.210
##  2 New York            48841 0.159
##  3 Pennsylvania        25600 0.0835
##  4 Texas               22500 0.0734
##  5 Ohio                16129 0.0526
##  6 Illinois            15625 0.0509
##  7 North Carolina      13689 0.0446
##  8 Massachusetts        8649 0.0282
##  9 Florida              7744 0.0252
## 10 Georgia              6241 0.0203
## # ... with 41 more rows
```

```
prop.table(table(tc$degree_length))
```

```
##
##       2 Year       4 Year        Other
## 0.3767238480 0.6229397915 0.0003363606
```

```
table(tc$state)
```

```
##
##        Alabama         Alaska        Arizona       Arkansas     California
##             54              6             34             46            254
##       Colorado    Connecticut       Delaware        Florida        Georgia
##             38             36              9             88             79
##         Hawaii          Idaho       Illinois        Indiana           Iowa
##             14             13            125             62             52
##         Kansas       Kentucky      Louisiana          Maine       Maryland
##             52             44             34             27             45
##  Massachusetts       Michigan      Minnesota    Mississippi       Missouri
##             93             78             71             32             73
##        Montana       Nebraska         Nevada  New Hampshire     New Jersey
##             22             33             10             21             54
##     New Mexico       New York North Carolina   North Dakota           Ohio
##             24            221            117             18            127
##       Oklahoma         Oregon   Pennsylvania   Rhode Island South Carolina
##             40             40            160             11             57
##   South Dakota      Tennessee          Texas           Utah        Vermont
##             18             62            150             14             19
##       Virginia     Washington  West Virginia      Wisconsin        Wyoming
##             79             60             30             67              8
```

```
tcFactored = tc %>%
  mutate(degFactor = as.factor(degree_length))

tcFactored
```

```
## # A tibble: 2,973 x 11
##    name      state state~1 type  degre~2 room_~3 in_st~4 in_st~5 out_o~6 out_o~7
##    <chr>     <chr> <chr>   <chr> <chr>     <dbl>   <dbl>   <dbl>   <dbl>   <dbl>
##  1 Aaniiih ~ Mont~ MT      Publ~ 2 Year       NA    2380    2380    2380    2380
##  2 Abilene ~ Texas TX      Priv~ 4 Year    10350   34850   45200   34850   45200
##  3 Abraham ~ Geor~ GA      Publ~ 2 Year     8474    4128   12602   12550   21024
##  4 Academy ~ Minn~ MN      For ~ 2 Year       NA   17661   17661   17661   17661
##  5 Academy ~ Cali~ CA      For ~ 4 Year    16648   27810   44458   27810   44458
##  6 Adams St~ Colo~ CO      Publ~ 4 Year     8782    9440   18222   20456   29238
##  7 Adelphi ~ New ~ NY      Priv~ 4 Year    16030   38660   54690   38660   54690
##  8 Adironda~ New ~ NY      Publ~ 2 Year    11660    5375   17035    9935   21595
##  9 Adrian C~ Mich~ MI      Priv~ 4 Year    11318   37087   48405   37087   48405
## 10 Advanced~ Virg~ VA      For ~ 2 Year       NA   13680   13680   13680   13680
## # ... with 2,963 more rows, 1 more variable: degFactor <fct>, and abbreviated
## #   variable names 1: state_code, 2: degree_length, 3: room_and_board,
## #   4: in_state_tuition, 5: in_state_total, 6: out_of_state_tuition,
## #   7: out_of_state_total
```

```
str(tcFactored)
```

```
## tibble [2,973 x 11] (S3: tbl_df/tbl/data.frame)
```

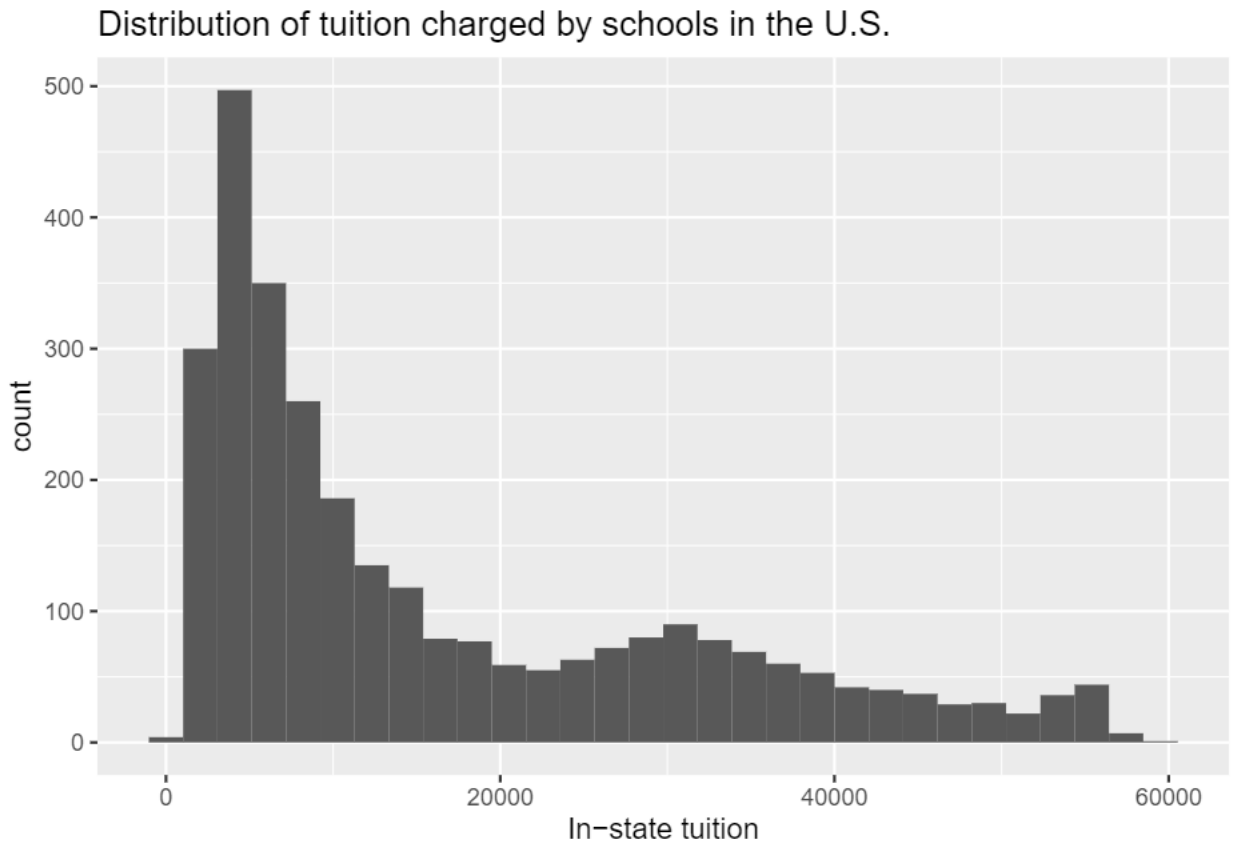
```
##  $ name                : chr [1:2973] "Aaniiih Nakoda College" "Abilene Christian University" "Abrah
##  $ state               : chr [1:2973] "Montana" "Texas" "Georgia" "Minnesota" ...
##  $ state_code          : chr [1:2973] "MT" "TX" "GA" "MN" ...
##  $ type                : chr [1:2973] "Public" "Private" "Public" "For Profit" ...
##  $ degree_length       : chr [1:2973] "2 Year" "4 Year" "2 Year" "2 Year" ...
##  $ room_and_board      : num [1:2973] NA 10350 8474 NA 16648 ...
##  $ in_state_tuition    : num [1:2973] 2380 34850 4128 17661 27810 ...
##  $ in_state_total      : num [1:2973] 2380 45200 12602 17661 44458 ...
##  $ out_of_state_tuition: num [1:2973] 2380 34850 12550 17661 27810 ...
##  $ out_of_state_total  : num [1:2973] 2380 45200 21024 17661 44458 ...
##  $ degFactor           : Factor w/ 3 levels "2 Year","4 Year",..: 1 2 1 1 2 2 2 1 2 1 ...
```

```
head(tcFactored)
```

```
## # A tibble: 6 x 11
##   name       state state~1 type  degre~2 room_~3 in_st~4 in_st~5 out_o~6 out_o~7
##   <chr>      <chr> <chr>   <chr> <chr>     <dbl>   <dbl>   <dbl>   <dbl>   <dbl>
## 1 Aaniiih N~ Mont~ MT      Publ~ 2 Year       NA    2380    2380    2380    2380
## 2 Abilene C~ Texas TX      Priv~ 4 Year    10350   34850   45200   34850   45200
## 3 Abraham B~ Geor~ GA      Publ~ 2 Year     8474    4128   12602   12550   21024
## 4 Academy C~ Minn~ MN      For ~ 2 Year       NA   17661   17661   17661   17661
## 5 Academy o~ Cali~ CA      For ~ 4 Year    16648   27810   44458   27810   44458
## 6 Adams Sta~ Colo~ CO      Publ~ 4 Year     8782    9440   18222   20456   29238
## # ... with 1 more variable: degFactor <fct>, and abbreviated variable names
## #   1: state_code, 2: degree_length, 3: room_and_board, 4: in_state_tuition,
## #   5: in_state_total, 6: out_of_state_tuition, 7: out_of_state_total
```

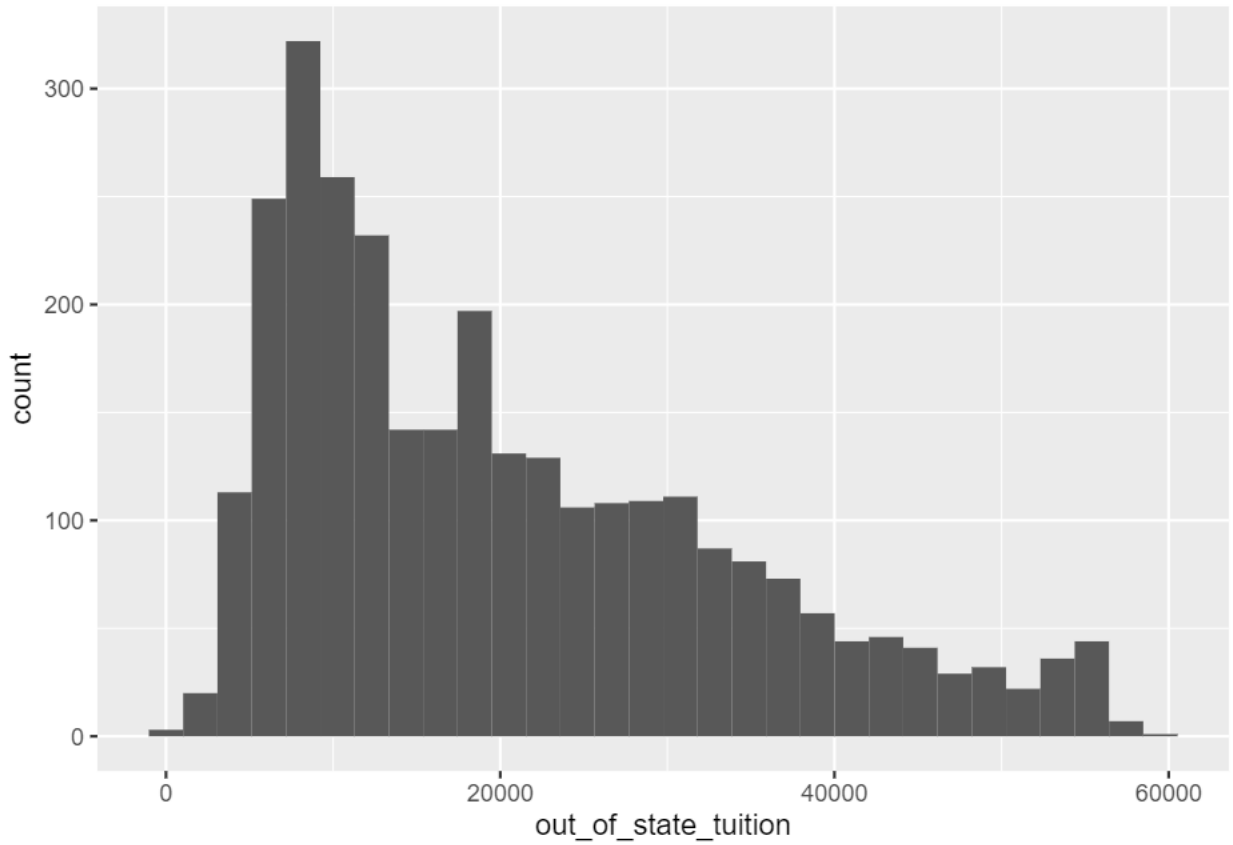
```
ggplot(tcFactored, aes(x=in_state_tuition)) + geom_histogram() +
  ggtitle("Distribution of tuition charged by schools in the U.S.")+
  xlab("In-state tuition")
```

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




```
ggplot(tcFactored, aes(x=out_of_state_tuition))+geom_histogram()
```

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

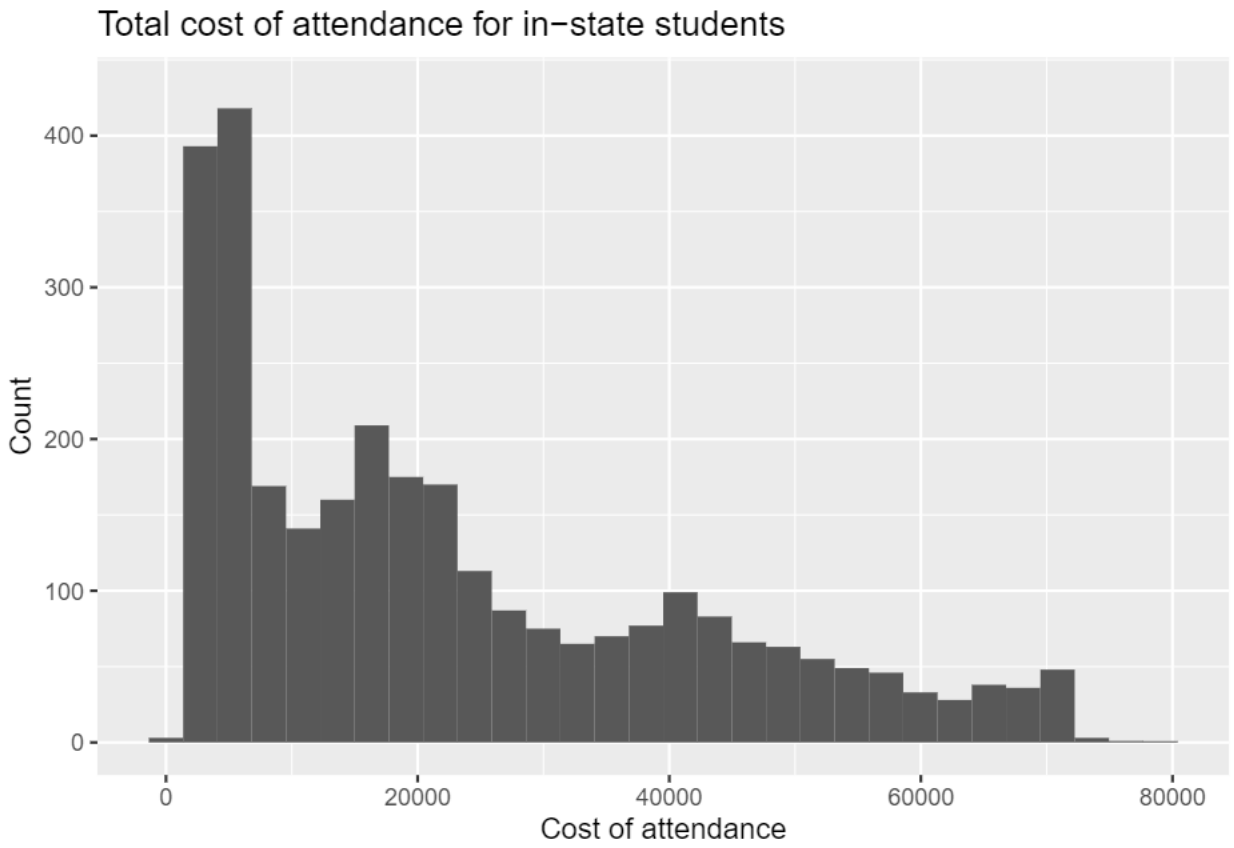



```
gatheredtc = tcFactored %>%
  gather(key="in_out", value="totalCost",c(in_state_total,out_of_state_total))
gatheredtc
```

```
## # A tibble: 5,946 x 11
##    name       state state~1 type  degre~2 room_~3 in_st~4 out_o~5 degFa~6 in_out
##    <chr>      <chr> <chr>   <chr> <chr>     <dbl>   <dbl>   <dbl> <fct>   <chr>
##  1 Aaniiih N~ Mont~ MT      Publ~ 2 Year       NA    2380    2380 2 Year  in_st~
##  2 Abilene C~ Texas TX      Priv~ 4 Year    10350   34850   34850 4 Year  in_st~
##  3 Abraham B~ Geor~ GA      Publ~ 2 Year     8474    4128   12550 2 Year  in_st~
##  4 Academy C~ Minn~ MN      For ~ 2 Year       NA   17661   17661 2 Year  in_st~
##  5 Academy o~ Cali~ CA      For ~ 4 Year    16648   27810   27810 4 Year  in_st~
##  6 Adams Sta~ Colo~ CO      Publ~ 4 Year     8782    9440   20456 4 Year  in_st~
##  7 Adelphi U~ New ~ NY      Priv~ 4 Year    16030   38660   38660 4 Year  in_st~
##  8 Adirondac~ New ~ NY      Publ~ 2 Year    11660    5375    9935 2 Year  in_st~
##  9 Adrian Co~ Mich~ MI      Priv~ 4 Year    11318   37087   37087 4 Year  in_st~
## 10 Advanced ~ Virg~ VA      For ~ 2 Year       NA   13680   13680 2 Year  in_st~
## # ... with 5,936 more rows, 1 more variable: totalCost <dbl>, and abbreviated
## #   variable names 1: state_code, 2: degree_length, 3: room_and_board,
## #   4: in_state_tuition, 5: out_of_state_tuition, 6: degFactor
```

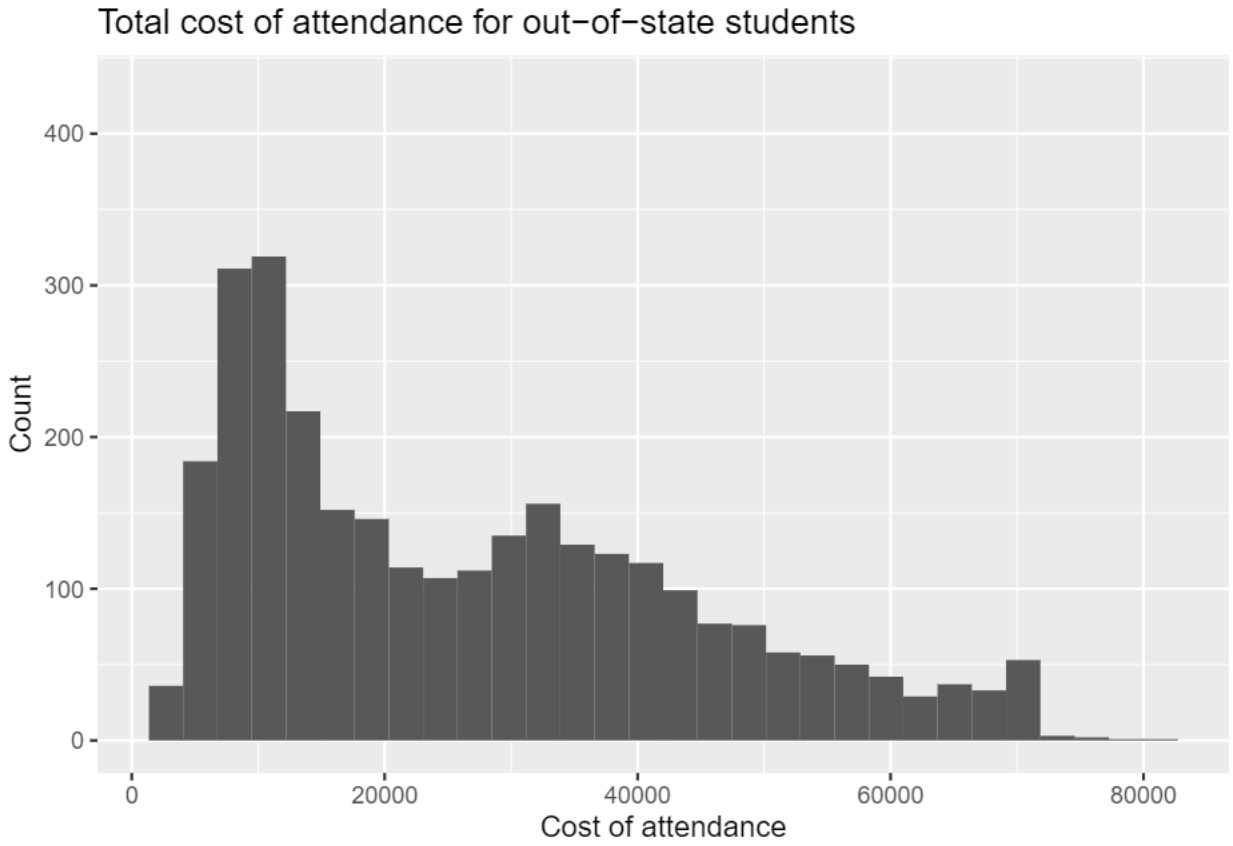
```
ggplot(tcFactored, aes(x=in_state_total))+geom_histogram()+expand_limits(x=80000,y=430) +
  ggtitle("Total cost of attendance for in-state students")+ # for the main title
  xlab("Cost of attendance")+ # for the x axis label
  ylab("Count") # for the y axis label
```

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



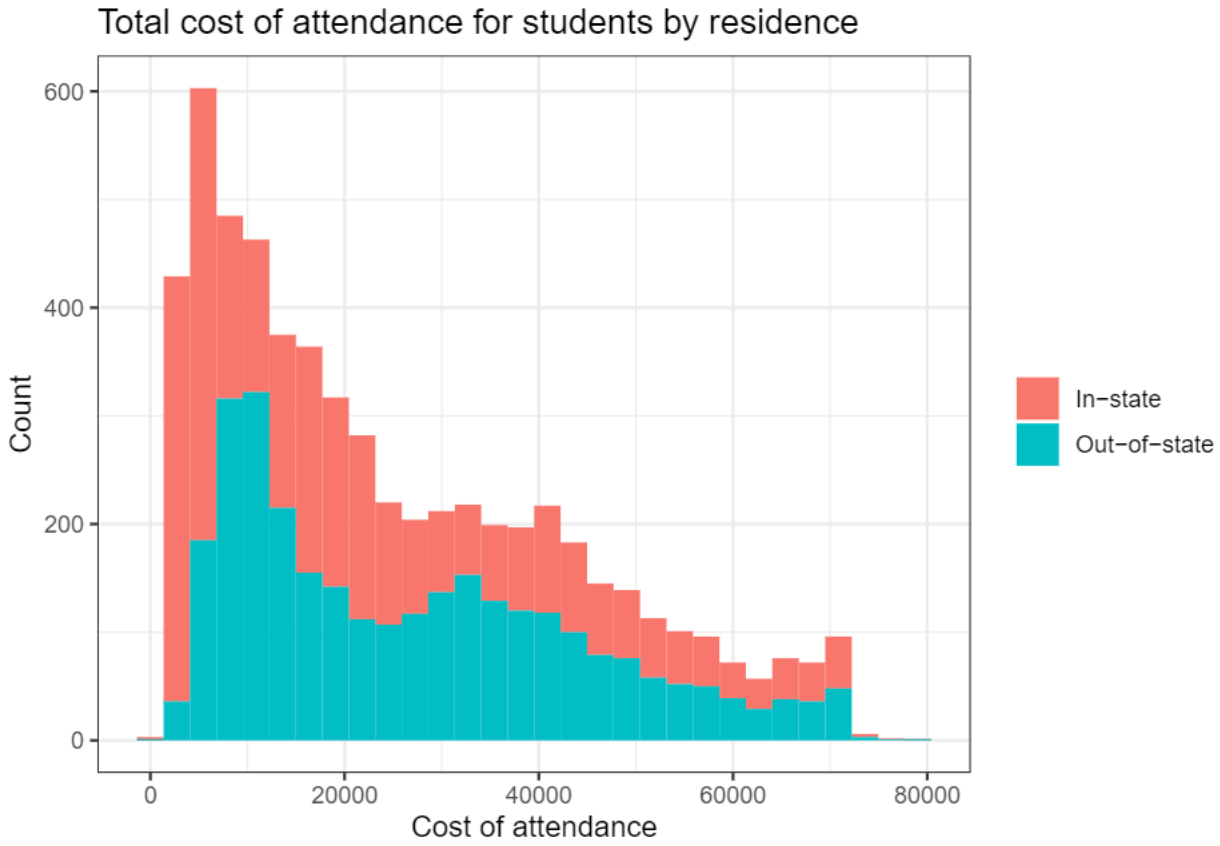

```
ggplot(tcFactored, aes(x=out_of_state_total))+geom_histogram()+expand_limits(x=80000,y=430) +
  ggtitle("Total cost of attendance for out-of-state students")+ # for the main title
  xlab("Cost of attendance")+ # for the x axis label
  ylab("Count") # for the y axis label
```

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




```
ggplot(gatheredtc, aes(x=totalCost,fill=in_out))+geom_histogram()+expand_limits(x=80000,y=430) +
  ggtitle("Total cost of attendance for students by residence")+ # for the main title
  xlab("Cost of attendance")+ # for the x axis label
  ylab("Count") + # for the y axis label
  theme_bw()+theme(
    legend.title = element_blank(),
    ) + scale_fill_discrete(name = "Student Residence", labels = c("In-state", "Out-of-state"))
```

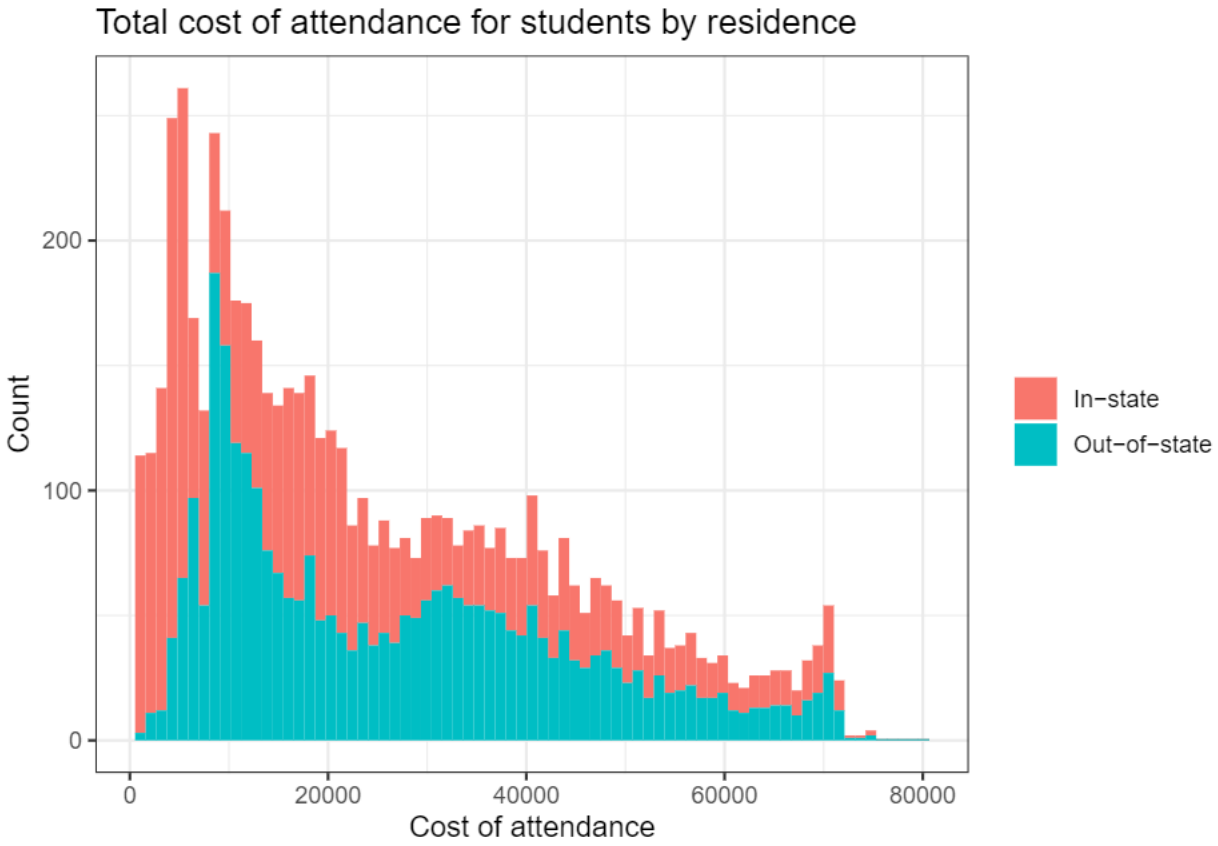
```
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```




```
#ggtitle(label) # for the main title
#xlab(label) # for the x axis label
#ylab(label) # for the y axis label
#labs(...) # for the main title, axis labels and legend titles
```

As the above plots show, it's clear that the distributions are skewed to the right which means that expensive schools are generally less common. It's interesting to see that both of these seem to have similar shapes, and a hint of evidence for a slight bimodal distribution.

```
ggplot(gatheredtc, aes(x=totalCost,fill=in_out))+geom_histogram(bins=75)+expand_limits(x=80000) +
  ggtitle("Total cost of attendance for students by residence")+ # for the main title
  xlab("Cost of attendance")+ # for the x axis label
  ylab("Count") + # for the y axis label
  theme_bw()+theme(
    legend.title = element_blank(),
    ) + scale_fill_discrete(name = "Student Residence", labels = c("In-state", "Out-of-state"))
```



Upon further inspection by increasing the bin number, the shape becomes more distinct. The second mode is mostly just a bump for the out-of-state group, but something interesting appears in the in-state group! Is there a cause for this disruption?

```
tcInStateSummr = tcFactored %>%
  group_by(degFactor) %>%
  summarize(median(in_state_total))

tcOutStateSummr = tcFactored %>%
  group_by(degFactor) %>%
  summarize(median(out_of_state_total))

tcInStateSummr
```

```
## # A tibble: 3 x 2
##   degFactor `median(in_state_total)`
##   <fct>                        <dbl>
## 1 2 Year                       4972.
## 2 4 Year                      28287
## 3 Other                        8448
```

```
tcOutStateSummr
```

```
## # A tibble: 3 x 2
##   degFactor `median(out_of_state_total)`
##   <fct>                             <dbl>
## 1 2 Year                            10291
## 2 4 Year                            34888
## 3 Other                             14640
```

This is a simple calculation of the median for 2-year and 4-year schools for total cost to out-of-state students.

```
tcFours = tcFactored %>%
  filter(degFactor=="4 Year")
tcFours
```

```
## # A tibble: 1,852 x 11
##    name      state state~1 type  degre~2 room_~3 in_st~4 in_st~5 out_o~6 out_o~7
##    <chr>     <chr> <chr>   <chr> <chr>     <dbl>   <dbl>   <dbl>   <dbl>   <dbl>
##  1 Abilene ~ Texas TX      Priv~ 4 Year    10350   34850   45200   34850   45200
##  2 Academy ~ Cali~ CA      For ~ 4 Year    16648   27810   44458   27810   44458
##  3 Adams St~ Colo~ CO      Publ~ 4 Year     8782    9440   18222   20456   29238
##  4 Adelphi ~ New ~ NY      Priv~ 4 Year    16030   38660   54690   38660   54690
##  5 Adrian C~ Mich~ MI      Priv~ 4 Year    11318   37087   48405   37087   48405
##  6 Adventis~ Flor~ FL      Priv~ 4 Year     4200   15150   19350   15150   19350
##  7 Agnes Sc~ Geor~ GA      Priv~ 4 Year    12330   41160   53490   41160   53490
##  8 Alabama ~ Alab~ AL      Publ~ 4 Year     8379    9698   18077   17918   26297
##  9 Alabama ~ Alab~ AL      Publ~ 4 Year     5422   11068   16490   19396   24818
## 10 Alaska B~ Alas~ AK      Priv~ 4 Year     5700    9300   15000    9300   15000
## # ... with 1,842 more rows, 1 more variable: degFactor <fct>, and abbreviated
## #   variable names 1: state_code, 2: degree_length, 3: room_and_board,
## #   4: in_state_tuition, 5: in_state_total, 6: out_of_state_tuition,
## #   7: out_of_state_total
```

```
tcTwos = tcFactored %>%
  filter(degFactor=="2 Year")
```

```
tc4YOOS_Summary = tcFours%>%
  summarise(count_4YOOS=n(),
            min=min(tcFours$out_of_state_total, na.rm=TRUE),
            Q1=quantile(tcFours$out_of_state_total, prob=0.25,na.rm=TRUE),
            med=median(tcFours$out_of_state_total, na.rm=TRUE), #or quantile(AQI,prob=0.5,na.rm=TRUE)
            Q3=quantile(tcFours$out_of_state_total, prob=0.75,na.rm=TRUE),
            max=max(tcFours$out_of_state_total, na.rm=TRUE))

tc4YIS_Summary = tcFours%>%
  summarise(count_4YIS=n(),
            min=min(tcFours$in_state_total, na.rm=TRUE),
            Q1=quantile(tcFours$in_state_total, prob=0.25,na.rm=TRUE),
            med=median(tcFours$in_state_total, na.rm=TRUE), #or quantile(AQI,prob=0.5,na.rm=TRUE)
            Q3=quantile(tcFours$in_state_total, prob=0.75,na.rm=TRUE),
            max=max(tcFours$in_state_total, na.rm=TRUE))

tc2YOOS_Summary = tcTwos%>%
  summarise(count_2YOOS=n(),
            min=min(tcTwos$out_of_state_total, na.rm=TRUE),
            Q1=quantile(tcTwos$out_of_state_total, prob=0.25,na.rm=TRUE),
            med=median(tcTwos$out_of_state_total, na.rm=TRUE), #or quantile(AQI,prob=0.5,na.rm=TRUE)
            Q3=quantile(tcTwos$out_of_state_total, prob=0.75,na.rm=TRUE),
            max=max(tcTwos$out_of_state_total, na.rm=TRUE))

tc2YIS_Summary = tcTwos%>%
  summarise(count_2YIS=n(),
            min=min(tcTwos$in_state_total, na.rm=TRUE),
            Q1=quantile(tcTwos$in_state_total, prob=0.25,na.rm=TRUE),
```

```
            med=median(tcTwos$in_state_total, na.rm=TRUE), #or quantile(AQI,prob=0.5,na.rm=TRUE)
            Q3=quantile(tcTwos$in_state_total, prob=0.75,na.rm=TRUE),
            max=max(tcTwos$in_state_total, na.rm=TRUE))

tc4YOOS_Summary
```

```
## # A tibble: 1 x 6
##   count_4YOOS   min    Q1   med    Q3   max
##         <int> <dbl> <dbl> <dbl> <dbl> <dbl>
## 1        1852  1430 24951 34888 46670 75003
```

```
tc4YIS_Summary
```

```
## # A tibble: 1 x 6
##   count_4YIS   min    Q1   med     Q3   max
##        <int> <dbl> <dbl> <dbl>  <dbl> <dbl>
## 1       1852  1430 18199 28287 44846. 75003
```

```
tc2YOOS_Summary
```

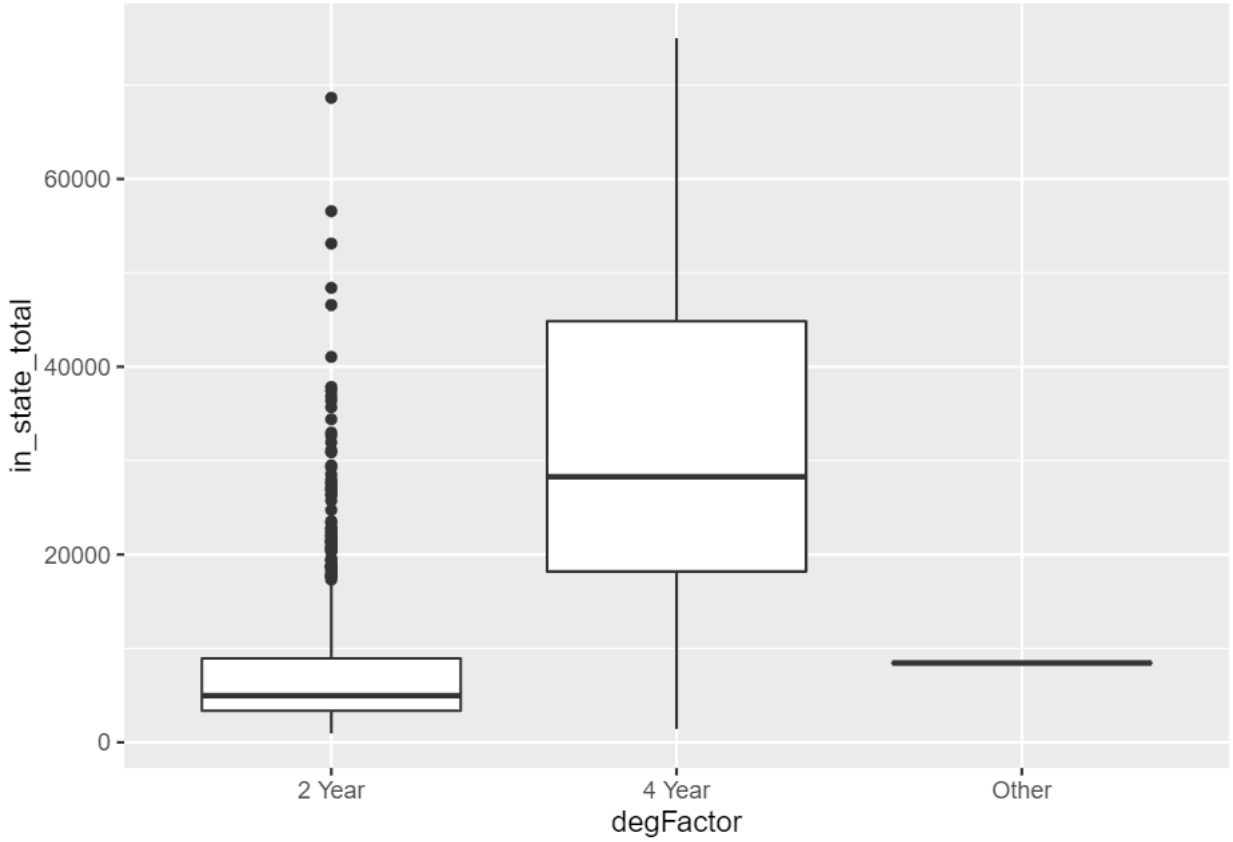
```
## # A tibble: 1 x 6
##   count_2YOOS   min    Q1   med    Q3   max
##         <int> <dbl> <dbl> <dbl> <dbl> <dbl>
## 1        1120  1376 8196. 10291 13598 68640
```

```
tc2YIS_Summary
```

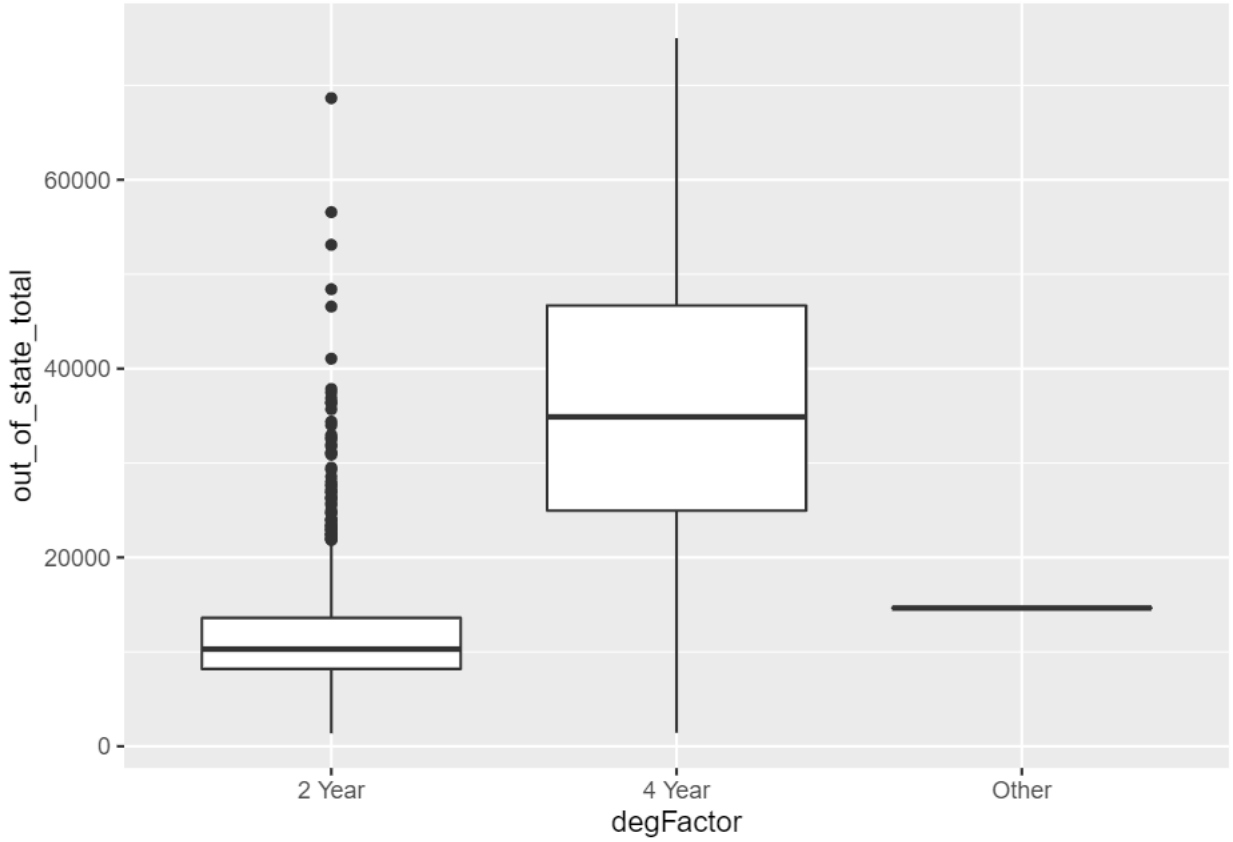
```
## # A tibble: 1 x 6
##   count_2YIS   min    Q1   med    Q3   max
##        <int> <dbl> <dbl> <dbl> <dbl> <dbl>
## 1       1120   962 3364. 4972.  8946 68640
```

These are the 5-number summaries for each of the categorical variables of interest.

```
ggplot(tcFactored, aes(x = degFactor, y = in_state_total)) +  # ggplot function
  geom_boxplot()
```



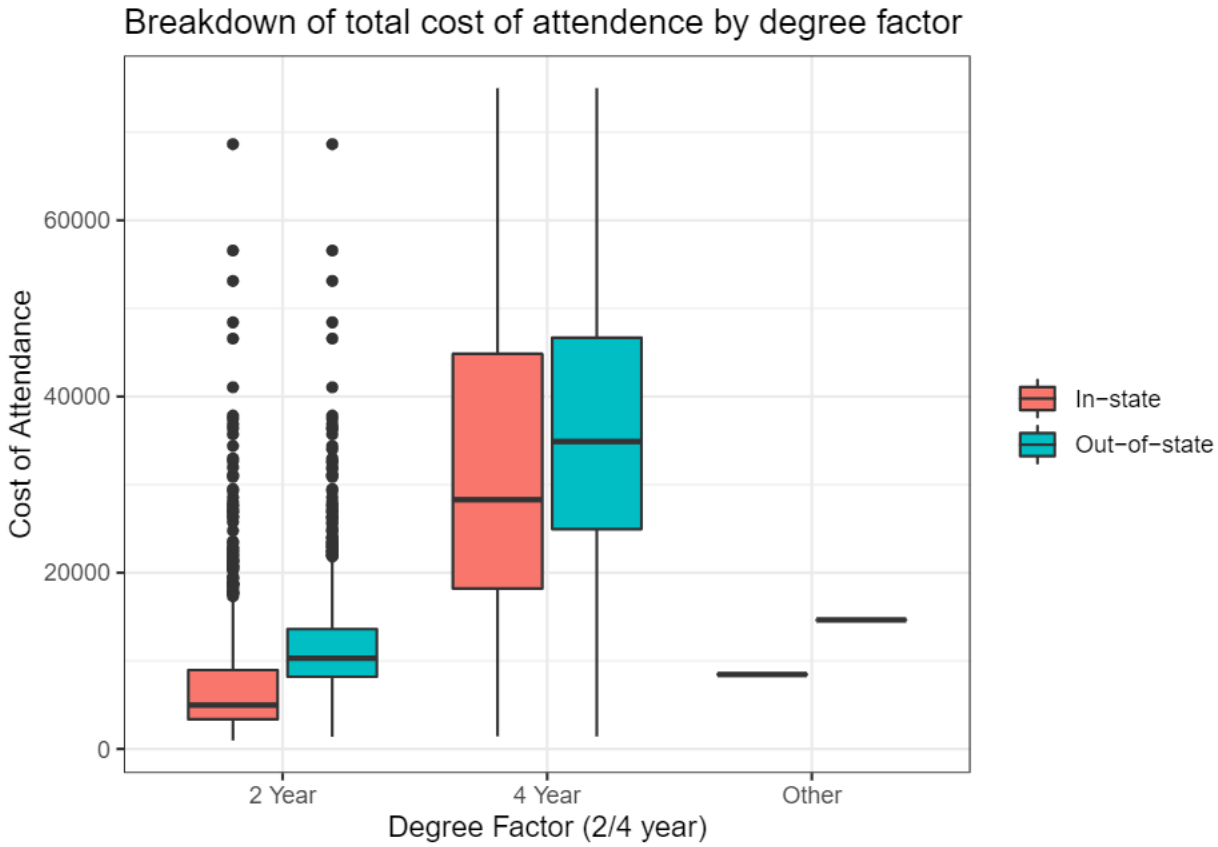

```
ggplot(tcFactored, aes(x = degFactor, y = out_of_state_total)) +  # ggplot function
  geom_boxplot()
```



These box plots (couldn't figure out how to make an overlayed boxplot with both in/out of state variables) show a clear difference in the general cost between 2-year and 4-year institutions, and that out-of-state students generally pay more.

```
#ggplot(tcFactored, aes(x=tcInStateSummr$degFactor, fill=tcInStateSummr$in_state_total)) +
#  geom_histogram( color="#e9ecef", alpha=0.6, position = 'identity') +
#  scale_fill_manual(values=c("#69b3a2", "#404080"))
```

```
ggplot(gatheredtc, aes(x = degFactor, y = totalCost, fill=in_out)) +  # ggplot function
  geom_boxplot()+
  ggtitle("Breakdown of total cost of attendence by degree factor")+ # for the main title
  xlab("Degree Factor (2/4 year)")+ # for the x axis label
  ylab("Cost of Attendance")+ # for the y axis label
  theme_bw()+theme(
    legend.title = element_blank(),
    ) + scale_fill_discrete(name = "Student Residence", labels = c("In-state", "Out-of-state"))
```



There is clearly a difference here between how much students should expect to pay given their residency status, but it isn't as absurdly significant as we were anticipating given that we hear from high school guidence counselors, specifically about 4-year institutions. Therefore, we should look for another potential explanation for the contribution to higher costs of attendance for some students.