MEM_second

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R Markdown

Question #1:BigBangTheory. (Attached Data: BigBangTheory)

The Big Bang Theory, a situation comedy featuring Johnny Galecki, Jim Parsons, and Kaley Cuoco-Sweeting, is one of the most-watched programs on network television. The first two episodes for the 2011–2012 season premiered on September 22, 2011; the first episode attracted 14.1 million viewers and the second episode attracted 14.7 million viewers. The attached data file BigBangTheory shows the number of viewers in millions for the first 21 episodes of the 2011–2012 season (the Big Bang theory website, April 17, 2012). a. Compute the minimum and the maximum number of viewers. b. Compute the mean, median, and mode. c. Compute the first and third quartiles. d. has viewership grown or declined over the 2011–2012 season? Discuss

```
#getwd()
data <- read.csv("data/BigBangTheory.csv", header = TRUE, sep = ",")
data
```

```
##              Air.Date Viewers..millions.
## 1  September 22, 2011               14.1
## 2  September 22, 2011               14.7
## 3  September 29, 2011               14.6
## 4     October 6, 2011               13.6
## 5    October 13, 2011               13.6
## 6    October 20, 2011               14.9
## 7    October 27, 2011               14.5
## 8    November 3, 2011               16.0
## 9   November 10, 2011               15.9
## 10  November 17, 2011               15.1
## 11   December 8, 2011               14.0
## 12   January 12, 2012               16.1
## 13   January 19, 2012               15.8
## 14   January 26, 2012               16.1
## 15   February 2, 2012               16.5
## 16   February 9, 2012               16.2
## 17  February 16, 2012               15.7
## 18  February 23, 2012               16.2
## 19      March 8, 2012               15.0
## 20     March 29, 2012               14.0
## 21      April 5, 2012               13.3
```

```
max(data$Viewers..millions.)
```

```
## [1] 16.5
```

```
min(data$Viewers..millions.)
```

```
## [1] 13.3
```

```
mean(data$Viewers..millions.)
```

```
## [1] 15.04286
```

```
median(data$Viewers..millions.)
```

```
## [1] 15
```

```
as.numeric(names(which.max(table(data$Viewers..millions.))))
```

```
## [1] 13.6
```

```
quantile(data$Viewers, 0.25, na.rm = TRUE)
```

```
##  25%
## 14.1
```

```
quantile(data$Viewers, 0.75, na.rm = TRUE)
```

```
## 75%
##  16
```

```
model <- lm(Viewers..millions. ~ Air.Date, data = data)
#coef(model)
summary(model)
```

```
##
## Call:
## lm(formula = Viewers..millions. ~ Air.Date, data = data)
##
## Residuals:
##          1          2          3          4          5          6          7
## -3.000e-01  3.000e-01 -2.082e-17  4.163e-17 -2.082e-17  3.469e-17  3.469e-17
##          8          9         10         11         12         13         14
## -1.388e-17 -6.939e-18  0.000e+00  1.735e-16  2.776e-17  6.939e-18  1.388e-17
##         15         16         17         18         19         20         21
##  1.388e-17 -2.082e-17 -6.939e-18  6.939e-18 -1.804e-16 -1.388e-17  1.249e-16
##
## Coefficients:
##                            Estimate Std. Error t value Pr(>|t|)
## (Intercept)                 13.3000     0.4243  31.348   0.0203 *
## Air.DateDecember 8, 2011     0.7000     0.6000   1.167   0.4511
## Air.DateFebruary 16, 2012    2.4000     0.6000   4.000   0.1560
## Air.DateFebruary 2, 2012     3.2000     0.6000   5.333   0.1180
## Air.DateFebruary 23, 2012    2.9000     0.6000   4.833   0.1299
## Air.DateFebruary 9, 2012     2.9000     0.6000   4.833   0.1299
## Air.DateJanuary 12, 2012     2.8000     0.6000   4.667   0.1344
## Air.DateJanuary 19, 2012     2.5000     0.6000   4.167   0.1500
## Air.DateJanuary 26, 2012     2.8000     0.6000   4.667   0.1344
## Air.DateMarch 29, 2012       0.7000     0.6000   1.167   0.4511
## Air.DateMarch 8, 2012        1.7000     0.6000   2.833   0.2160
## Air.DateNovember 10, 2011    2.6000     0.6000   4.333   0.1444
## Air.DateNovember 17, 2011    1.8000     0.6000   3.000   0.2048
## Air.DateNovember 3, 2011     2.7000     0.6000   4.500   0.1392
## Air.DateOctober 13, 2011     0.3000     0.6000   0.500   0.7048
## Air.DateOctober 20, 2011     1.6000     0.6000   2.667   0.2284
## Air.DateOctober 27, 2011     1.2000     0.6000   2.000   0.2952
## Air.DateOctober 6, 2011      0.3000     0.6000   0.500   0.7048
## Air.DateSeptember 22, 2011   1.1000     0.5196   2.117   0.2809
## Air.DateSeptember 29, 2011   1.3000     0.6000   2.167   0.2753
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.4243 on 1 degrees of freedom
## Multiple R-squared:  0.9913, Adjusted R-squared:  0.8252
## F-statistic: 5.968 on 19 and 1 DF,  p-value: 0.3131
```

```
#p<0.05  no contact
```

Question #2: NBAPlayerPts. (Attached Data: NBAPlayerPts)

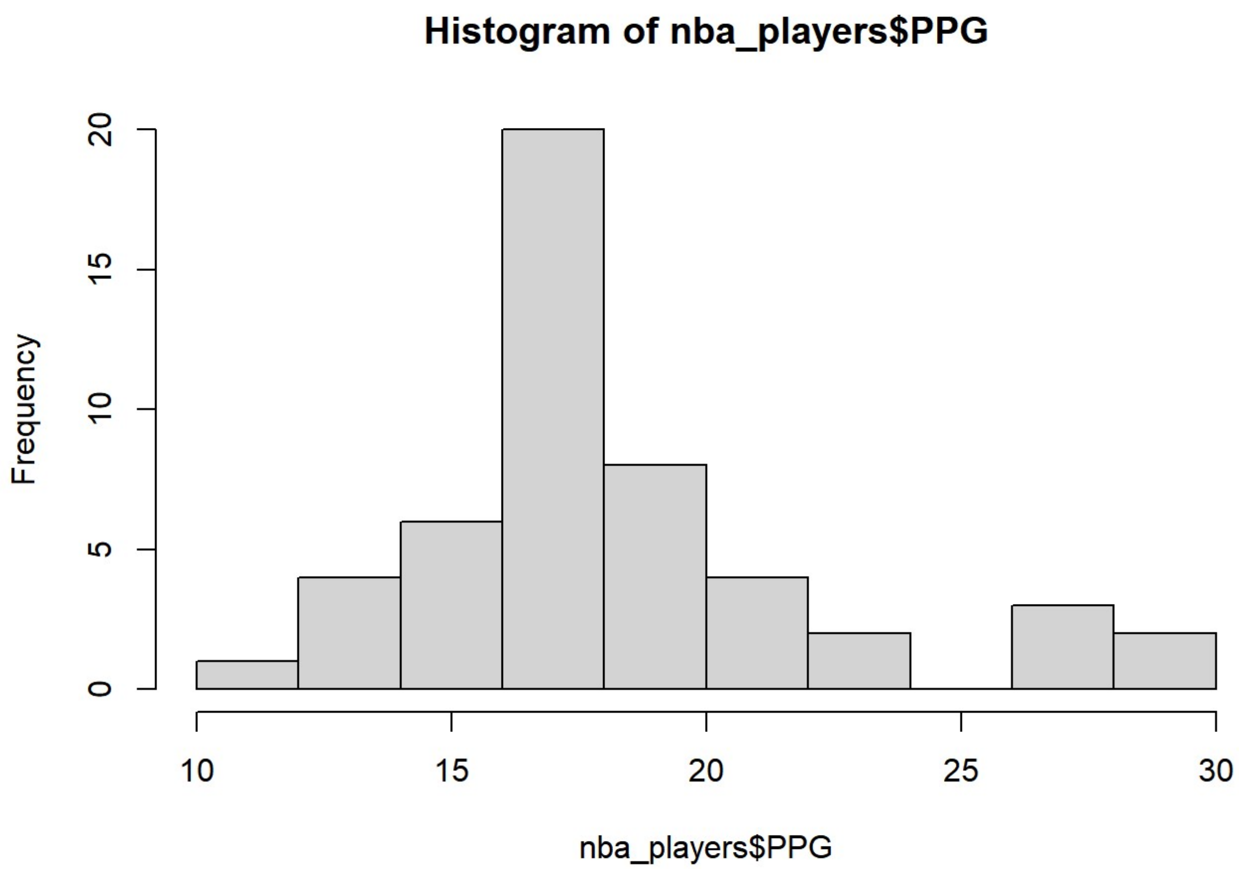
CbSSports.com developed the Total Player Rating system to rate players in the National Basketball Association (NBA) based on various offensive and defensive statistics. The attached data file NBAPlayerPts shows the average number of points scored per game (PPG) for 50 players with the highest ratings for a portion of the 2012–2013 NBA season (CbSSports.com website, February 25, 2013). Use classes starting at 10 and ending at 30 in increments of 2 for PPG in the following. a. Show the frequency distribution. b.

Show the relative frequency distribution. c. Show the cumulative percent frequency distribution. d. Develop a histogram for the average number of points scored per game. e. Do the data appear to be skewed? Explain. f. What percentage of the players averaged at least 20 points per game?

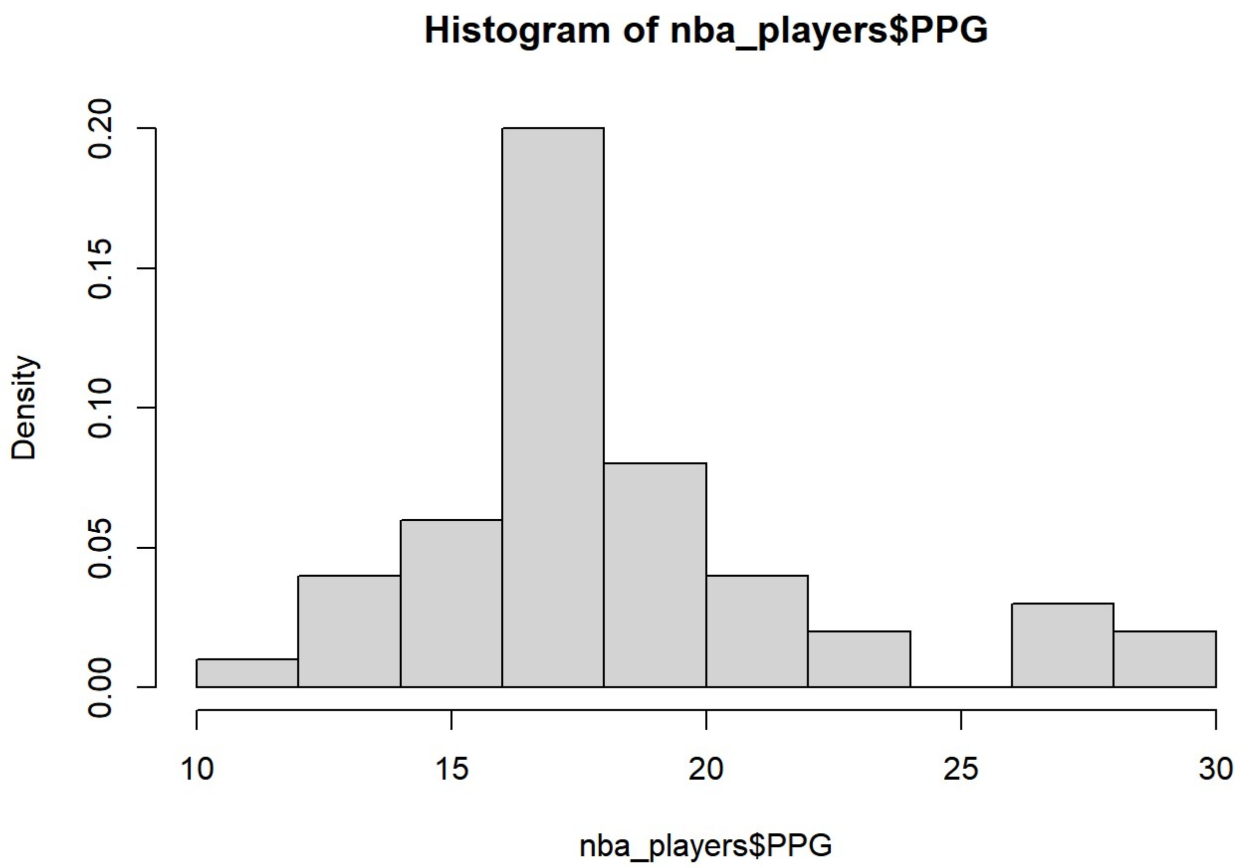
```
nba_players <- read.csv("data/NBAPlayerPts.csv", header = TRUE, sep = ",")
nba_players
```

```
##    Rank                         Player  PPG
## 1     1              LeBron James, MIA 27.0
## 2     2              Kevin Durant, OKC 28.8
## 3     3              James Harden, HOU 26.4
## 4     4                Kobe Bryant, LAL 27.1
## 5     5         Russell Westbrook, OKC 22.9
## 6     6            Carmelo Anthony, NY 28.4
## 7     7                  David Lee, GS 19.2
## 8     8              Stephen Curry, GS 21.0
## 9     9         LaMarcus Aldridge, POR 20.8
## 10   10               Paul George, IND 17.6
## 11   11                Tony Parker, SA 21.1
## 12   12              Jrue Holiday, PHI 19.2
## 13   13               Dwyane Wade, MIA 21.2
## 14   14             Nicolas Batum, POR 15.5
## 15   15                Josh Smith, ATL 17.2
## 16   16                Al Horford, ATL 16.7
## 17   17              Al Jefferson, UTA 17.6
## 18   18             Blake Griffin, LAC 18.5
## 19   19               Paul Pierce, BOS 18.3
## 20   20 Damian Lillard, POR (Rookie) 18.3
## 21   21              Kyrie Irving, CLE 23.3
## 22   22             Dwight Howard, LAL 16.4
## 23   23          Brandon Jennings, MIL 18.9
## 24   24                 Luol Deng, CHI 16.5
## 25   25            Deron Williams, BKN 17.0
## 26   26               Joakim Noah, CHI 11.7
## 27   27             Zach Randolph, MEM 15.7
## 28   28                  Rudy Gay, TOR 18.0
## 29   29              Kemba Walker, CHA 17.7
## 30   30          Chandler Parsons, HOU 14.6
## 31   31               Greg Monroe, DET 15.7
## 32   32                David West, IND 17.2
## 33   33               Monta Ellis, MIL 18.2
## 34   34                 O.J. Mayo, DAL 17.5
## 35   35                Marc Gasol, MEM 13.6
## 36   36                 Ty Lawson, DEN 16.3
## 37   37                Chris Paul, LAC 16.2
## 38   38            Greivis Vasquez, NO 13.6
## 39   39                Chris Bosh, MIA 17.1
## 40   40                Tim Duncan, SA 16.7
## 41   41               Joe Johnson, BKN 17.0
## 42   42          DeMarcus Cousins, SAC 17.3
## 43   43             DeMar DeRozan, TOR 17.5
## 44   44               Evan Turner, PHI 14.0
## 45   45          Danilo Gallinari, DEN 16.9
## 46   46              Klay Thompson, GS 16.3
## 47   47              Paul Millsap, UTA 15.1
## 48   48            Nikola Vucevic, ORL 12.3
## 49   49               Brook Lopez, BKN 18.7
## 50   50                George Hill, IND 14.6
```

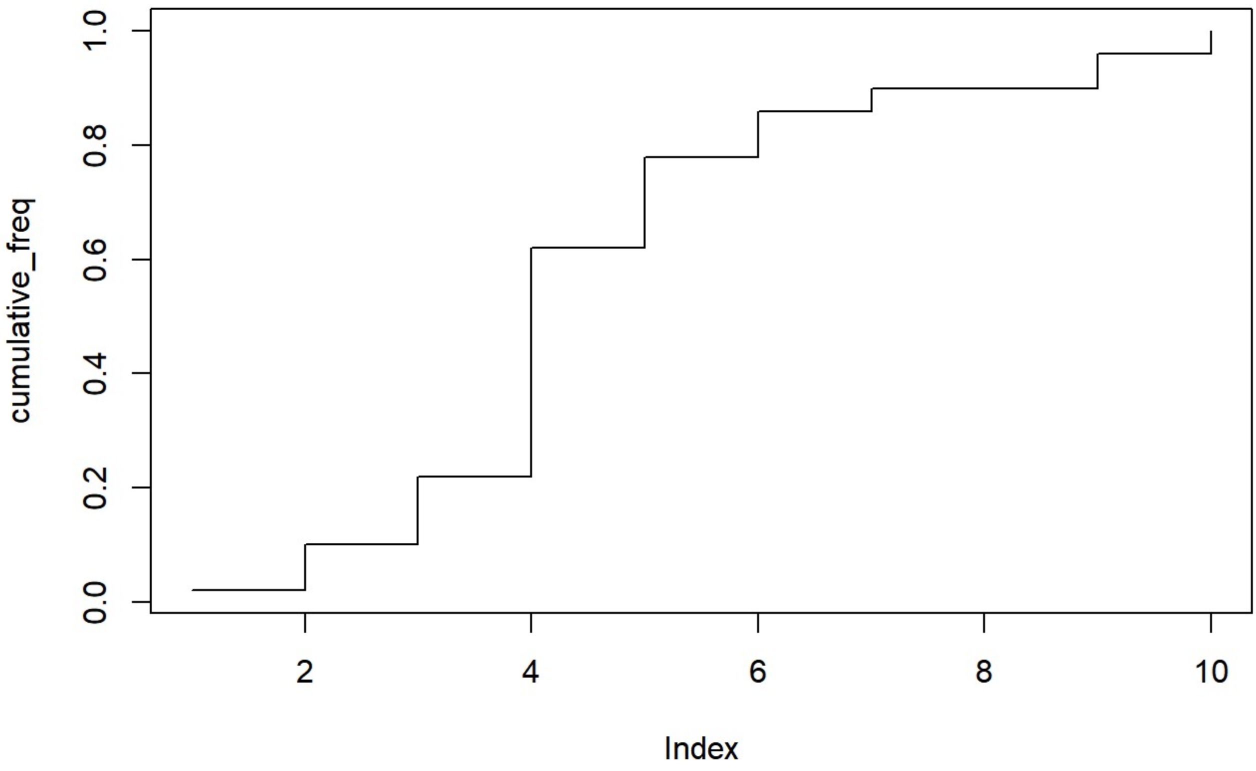
```
# a. Show the frequency distribution.
breaks <- seq(10, 30, by = 2)
hist(nba_players$PPG, breaks = breaks)
```



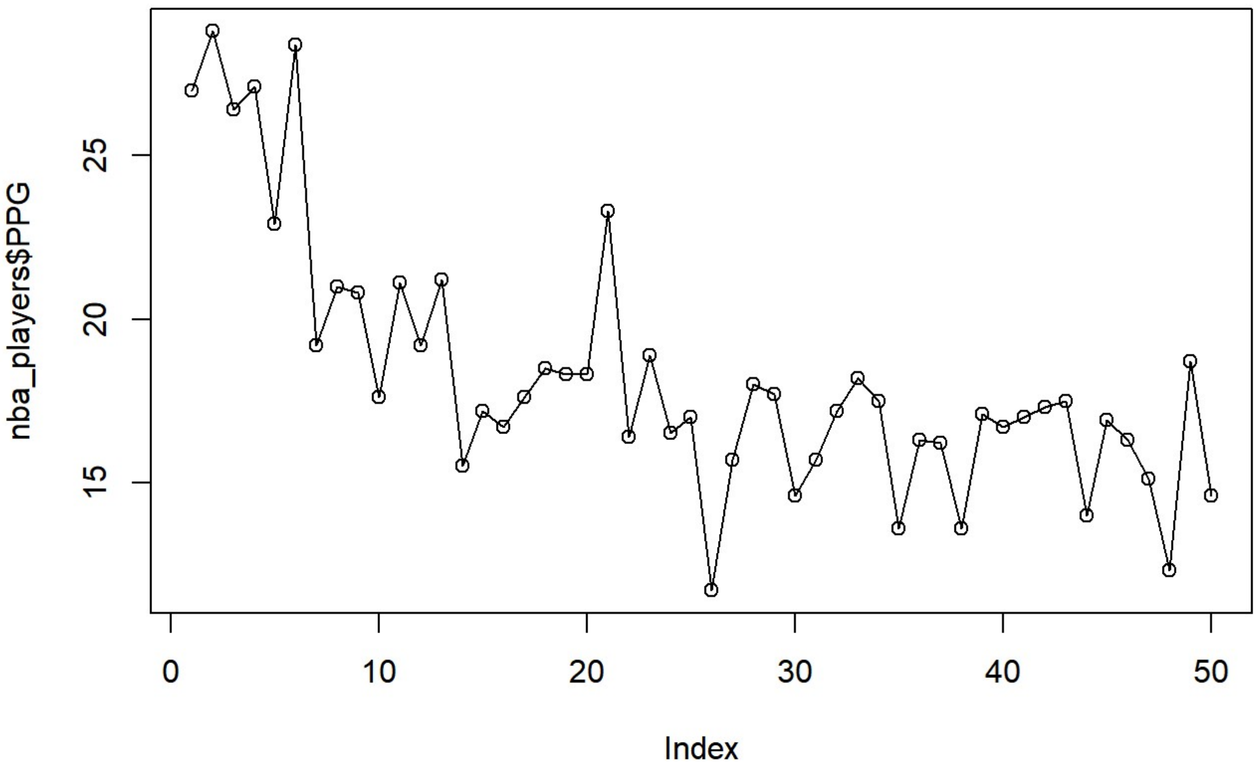

```
# b. Show the relative frequency distribution.
hist(nba_players$PPG, breaks = breaks, freq = FALSE)
```



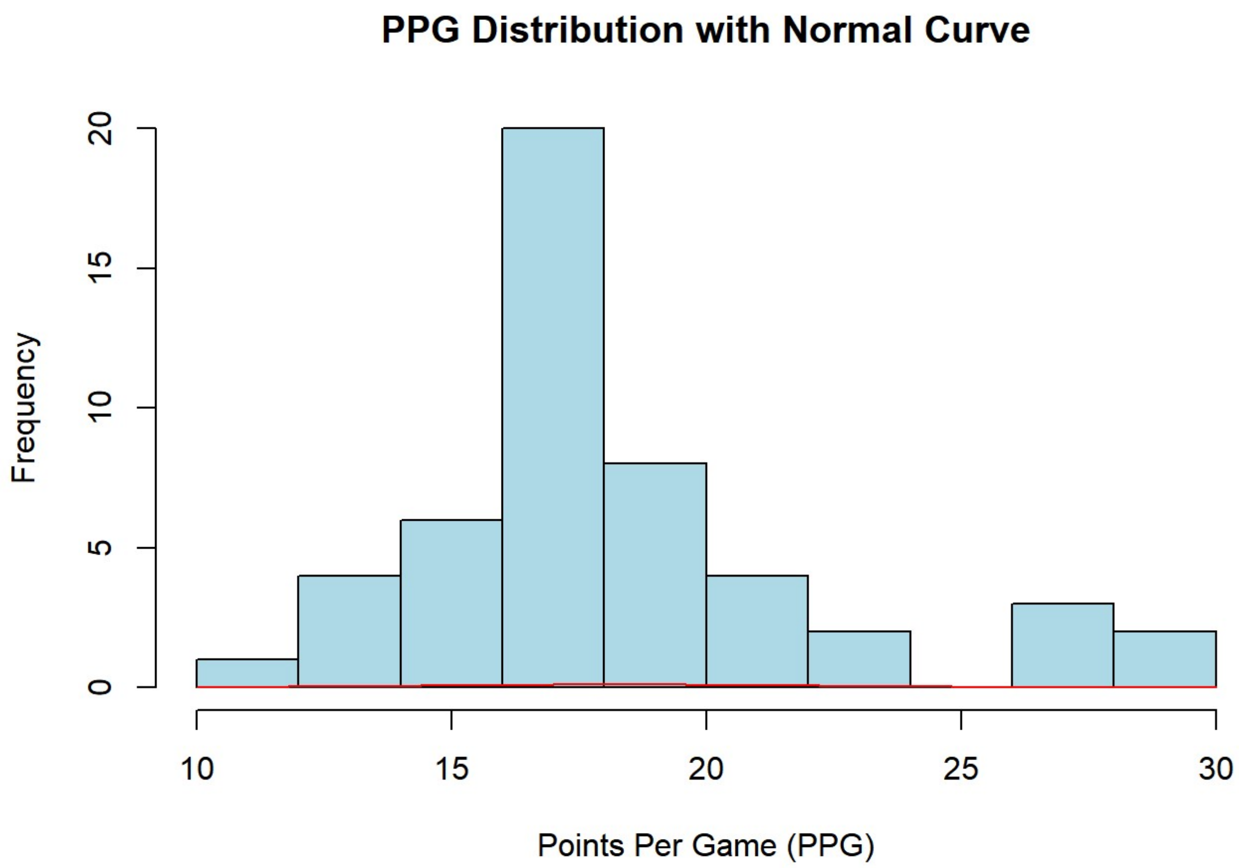

```
# c. Show the cumulative percent frequency distribution.
cumulative_freq <- cumsum(hist(nba_players$PPG, breaks = breaks, plot = FALSE)$counts) / s
um(hist(nba_players$PPG, breaks = breaks, plot = FALSE)$counts)
plot(cumulative_freq, type = "s")
```




```
# d. Develop a histogram for the average number of points scored per game
plot(nba_players$PPG, type="o")
```




```
# e. Do the data appear to be skewed? Explain.
hist(nba_players$PPG, main="PPG Distribution with Normal Curve", xlab="Points Per Game (PP
G)", col="lightblue")
curve(dnorm(x, mean=mean(nba_players$PPG), sd=sd(nba_players$PPG)), add=TRUE, col="red")
```




```
# f. What percentage of the players averaged at least 20 points per game?
count_players <- sum(nba_players$PPG >= 20)
count_players
```

```
## [1] 11
```

Question #3: A researcher reports survey results by stating that the standard error of the mean is 20. The population standard deviation is 500.

```
# a. How large was the sample used in this survey?
sigma <- 500
SE <- 20
n <- (sigma / SE) ^ 2
n
```

```
## [1] 625
```

```
# b. What is the probability that the point estimate was within ±25 of the population mea
n?
mu <- 0
x <- 25
z <- (x - mu) / SE
probability <- pnorm(z) - pnorm(-z)
probability
```

```
## [1] 0.7887005
```

Question #4: Young Professional Magazine (Attached Data: Professional)

Young Professional magazine was developed for a target audience of recent college graduates who are in their first 10 years in a business/professional career. In its two years of publication, the magazine has been fairly successful. Now the publisher is interested in expanding the magazine's advertising base. Potential advertisers continually ask about the demographics and interests of subscribers to young Professionals. To collect this information, the magazine commissioned a survey to develop a profile of its subscribers. The survey results will be used to help the magazine choose articles of interest and provide advertisers with a profile of subscribers. As a new employee of the magazine, you have been asked to help analyze the survey results. Some of the survey questions follow: 1. What is your age? 2. Are you: Male_________ Female___________ 3. Do you plan to make any real estate purchases in the next two years? Yes______ No______ 4. What is the approximate total value of financial investments, exclusive of your home, owned by you or members of your household? 5. How many stock/bond/mutual fund transactions have you made in the past year? 6. Do you have broadband access to the Internet at home? Yes______ No______ 7. Please indicate your total household income last year. ***8. Do you have children? Yes***___ No______ The file entitled Professional contains the responses to these questions. Managerial Report: Prepare a managerial report summarizing the results of the survey. In addition to statistical summaries, discuss how the magazine might use these results to attract advertisers. You might also comment on how the survey results could be used by the magazine's editors to identify topics that would be of interest to readers. Your report should address the following issues, but do not limit your analysis to just these areas.

```
data <- read.csv("data/Professional.csv", header = TRUE, sep = ",")

#a. Develop appropriate descriptive statistics to summarize the data.
colnames(data) <- c("age", "gender", "real_estate","investments","num_trans","has_broadban
d", "income", "have_children")
Professional <- data
Professional
```

```
##    age gender real_estate investments num_trans has_broadband income
## 1   38 Female          No       12200         4           Yes  75200
## 2   30   Male          No       12400         4           Yes  70300
## 3   41 Female          No       26800         5           Yes  48200
## 4   28 Female         Yes       19600         6            No  95300
## 5   31 Female         Yes       15100         5            No  73300
## 6   32   Male          No       39700         3           Yes 123400
## 7   32   Male         Yes       21900         2           Yes  73900
## 8   26 Female         Yes       41900         2           Yes  54300
## 9   26   Male         Yes       16100         4           Yes  93100
## 10  34 Female         Yes       18400        11           Yes  60100
## 11  33 Female          No       33800         3            No  48600
## 12  35 Female         Yes       15500         6            No  43500
## 13  28 Female          No       17300         7           Yes  73600
## 14  30   Male          No       47900         5           Yes  68200
## 15  30 Female          No       28200         3            No  61900
## 16  30   Male         Yes       19400         6            No  57600
## 17  33   Male         Yes       31000        12            No  82300
## 18  28   Male          No       21300         6            No  64600
## 19  27 Female          No       21300        10           Yes  61100
## 20  23 Female          No       21300         7           Yes  31200
## 21  30 Female          No       34100         6           Yes  92600
## 22  28   Male          No       32600         7           Yes  68300
## 23  41   Male         Yes           0        10           Yes  35100
## 24  29   Male         Yes       20800        10           Yes  85700
## 25  33 Female         Yes       23100         6           Yes 140300
## 26  30   Male          No       39800         9           Yes 108200
## 27  29 Female          No       17900         2            No  61100
## 28  33   Male          No       33300         2            No  33900
## 29  30 Female         Yes       21800         8           Yes  54400
## 30  30   Male          No       54000         7           Yes  61200
## 31  36 Female         Yes       34800        12            No  58000
## 32  33 Female         Yes       36100         7           Yes  90700
## 33  28 Female         Yes       44300         5           Yes  95200
## 34  28   Male          No       21400         5            No  50500
## 35  28   Male         Yes        8600         6           Yes  33800
## 36  35   Male          No       23200         3            No 147400
## 37  31   Male          No       24800         4            No  92600
## 38  33 Female          No       26600         5           Yes  66200
## 39  32   Male          No       33100         8            No  45700
## 40  28   Male          No       27000         4            No  60500
## 41  27   Male          No       48700         6            No 110600
## 42  30 Female         Yes       17100         4            No  60300
## 43  29   Male          No       19900         6            No  75700
## 44  28   Male          No       13200         9            No  70100
## 45  29 Female         Yes       32400         6            No  42100
## 46  32 Female          No       14200         5           Yes  41700
## 47  33   Male          No       20100         5            No  96900
## 48  23   Male         Yes       32000         5           Yes  65700
## 49  29 Female          No       41900         3            No  50200
## 50  31   Male          No       12000         3            No  61700
## 51  33 Female          No       14000         6            No  44500
## 52  37 Female          No       10000         4           Yes  51900
## 53  28 Female          No       27200         5           Yes 119100
```

```
## 54  27 Female          Yes       34500         4          Yes  49200
## 55  33 Female           No       26000         6          Yes  39000
## 56  31 Female           No       53400         3          Yes  35000
## 57  30   Male           No       23100         7          Yes 104700
## 58  23   Male           No       24900         5           No  49300
## 59  33   Male           No       10900        10          Yes  74000
## 60  31 Female           No       52500         2          Yes  57100
## 61  24 Female           No       24600        16          Yes  51400
## 62  35 Female           No       28800         6           No  62100
## 63  36 Female          Yes       37300        11          Yes 103000
## 64  24   Male          Yes       21100         9          Yes  97900
## 65  25   Male           No       40900         3           No 123100
## 66  26 Female           No       24700         7          Yes 322500
## 67  31   Male           No       33600         8          Yes  54800
## 68  26   Male          Yes       20000         6           No  66500
## 69  26   Male           No       23900         2           No  33700
## 70  28   Male          Yes       11700         8           No  73600
## 71  26 Female           No       19200         5          Yes  71300
## 72  34   Male           No       11900         6           No  74200
## 73  32   Male           No       17700         8          Yes  70000
## 74  30   Male           No       23900         6          Yes  40800
## 75  29 Female          Yes       27500         4          Yes  72500
## 76  23   Male          Yes       25300         4           No  53300
## 77  28 Female           No       66900         5           No  45600
## 78  25   Male           No       18800         5          Yes  73900
## 79  35   Male           No       24400         3          Yes  83600
## 80  31   Male           No       45500         9          Yes 124700
## 81  35   Male          Yes       54700         3          Yes 101600
## 82  32 Female           No       32200         4           No 205900
## 83  29   Male           No       16200         3          Yes  69700
## 84  34 Female           No       16000         9           No  95700
## 85  30 Female          Yes       24000         3           No  46100
## 86  29   Male           No       28800         3          Yes 118600
## 87  42   Male           No       14100         5          Yes  65400
## 88  37 Female          Yes       17700        11          Yes 149300
## 89  32   Male           No       29800         7          Yes 125000
## 90  33 Female          Yes       27200         3          Yes  39800
## 91  36   Male          Yes       43000         2           No  83500
## 92  32 Female          Yes       15500         7          Yes  38700
## 93  35   Male          Yes        8700         6           No 102400
## 94  20   Male           No       13900        14          Yes  57700
## 95  30   Male           No       14200         6          Yes  16200
## 96  31 Female          Yes       27100         3           No  43100
## 97  28   Male          Yes       22300         3           No  43700
## 98  24 Female          Yes       29500         4          Yes  39600
## 99  30   Male           No       18800         2          Yes 127500
## 100 23 Female          Yes       26400         9          Yes  33500
## 101 29   Male          Yes       16400         5          Yes  48100
## 102 33   Male           No       39500         3          Yes  52800
## 103 24   Male          Yes       20900         6          Yes  54800
## 104 25 Female           No       52800         5          Yes  46500
## 105 38   Male           No       36500         4          Yes  60400
## 106 22 Female           No       30400        11          Yes 202400
## 107 32 Female           No       39800         7           No  71300
## 108 28 Female          Yes       18100         9           No  62800
```

```
## 109  32   Male         Yes       69500         7           No  43900
## 110  33 Female          No       33000         5          Yes  52200
## 111  32 Female         Yes       32100         3           No  64400
## 112  24   Male         Yes       15200         8           No  77400
## 113  23 Female         Yes       49800         3          Yes  65900
## 114  23   Male          No       28100         6           No  54100
## 115  38   Male          No       15200         6          Yes  77400
## 116  29   Male          No       30800         3          Yes  85900
## 117  28   Male          No       21200         3           No 148600
## 118  29   Male          No       24600         4          Yes  82100
## 119  36   Male         Yes       24700         9          Yes  64400
## 120  35 Female         Yes       26300        16           No  86200
## 121  34 Female         Yes       32200         6           No 177100
## 122  23   Male          No       20300         6          Yes  68300
## 123  31 Female          No       60900         6          Yes  67900
## 124  28   Male          No       15800        11          Yes  57300
## 125  33 Female          No       31700         6          Yes  83600
## 126  31   Male         Yes           0         5          Yes  77500
## 127  26 Female         Yes       20900         9          Yes  61700
## 128  38 Female          No       37900        12           No  85600
## 129  28   Male         Yes       22400         7          Yes  59900
## 130  27   Male          No       26600         5          Yes  43100
## 131  31   Male         Yes       20800        10           No  65700
## 132  34   Male          No       31100         7          Yes  80500
## 133  29   Male          No       31200         5          Yes  88400
## 134  27   Male          No           0         2           No  40200
## 135  26   Male         Yes       38900         7          Yes  84000
## 136  33   Male         Yes       29500         4          Yes  34400
## 137  33   Male          No       16100         5           No  55800
## 138  34   Male          No       15800         7          Yes  64900
## 139  31   Male          No       27500         4          Yes  41100
## 140  37 Female          No       13000         7           No  39100
## 141  27   Male         Yes       68100         5           No  58200
## 142  32   Male         Yes       18500         7          Yes  46500
## 143  25 Female          No       27100         2          Yes  45100
## 144  31 Female          No       25900         5          Yes  69900
## 145  38   Male          No       18400         2           No  63700
## 146  31 Female          No       59200         4          Yes  40500
## 147  28 Female          No       67900         5           No  62600
## 148  29 Female          No       36700         7          Yes  73400
## 149  34 Female          No       32400         9          Yes  35000
## 150  35 Female         Yes       10300         4          Yes 114000
## 151  30   Male          No       39300         7          Yes  70800
## 152  32 Female          No       13800         6          Yes  60300
## 153  31   Male          No       11100         4          Yes  78700
## 154  29 Female          No       28600         2           No 179700
## 155  31   Male          No       22100         6          Yes 157200
## 156  31 Female          No       16700         6          Yes  67300
## 157  22 Female         Yes       19400         6          Yes  49800
## 158  19   Male         Yes       54600         4          Yes  43400
## 159  31 Female         Yes       41500         2          Yes  71100
## 160  22 Female          No       23300         9           No  42100
## 161  26   Male          No       29700         8          Yes  42200
## 162  34   Male         Yes       33200         2          Yes  63300
## 163  37   Male         Yes       56300         5           No  55700
```

```
## 164  36 Female          No       25900         5          Yes 107900
## 165  27 Female         Yes       63500         6          Yes  44800
## 166  32   Male         Yes       18700         7          Yes  94700
## 167  27 Female          No       49700         4          Yes 112700
## 168  32   Male         Yes       15000         5          Yes 114900
## 169  24 Female         Yes        8200         7           No 112700
## 170  38 Female         Yes       36300         9           No  60900
## 171  33 Female          No       50200         7          Yes 137800
## 172  19   Male          No       13500        10          Yes  47200
## 173  33   Male         Yes       37500         4          Yes  70900
## 174  25 Female          No       26800         7           No  52000
## 175  27   Male          No       30300         5          Yes 166500
## 176  35 Female          No       46300        18          Yes  88000
## 177  29   Male         Yes       14400         9           No  41800
## 178  31   Male         Yes           0         4          Yes  60300
## 179  29 Female         Yes       18800         5          Yes  53400
## 180  31 Female          No       40900         5           No  46700
## 181  32   Male         Yes       23300         7          Yes  59600
## 182  22 Female          No       11900         4          Yes  27700
## 183  29   Male         Yes       28100        10           No  48900
## 184  28 Female          No       20400         8           No  56600
## 185  26   Male          No       14900         7           No  32500
## 186  33 Female          No       33900         3          Yes  74500
## 187  35   Male          No       15100         6           No  69800
## 188  27   Male          No      133400         5          Yes  48100
## 189  33 Female         Yes       18300         7          Yes  95900
## 190  30 Female         Yes       28700        10          Yes  76500
## 191  28   Male         Yes       50900         6          Yes  43700
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## 193  34 Female         Yes       30700         0          Yes 140100
## 194  28   Male         Yes       64300         5          Yes  76600
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## 199  31 Female         Yes       18400         5           No  87900
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## 220  30 Female          No        9400          5            No  57400
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## 315           Yes NA    NA NA NA NA
## 316            No NA    NA NA NA NA
## 317            No NA    NA NA NA NA
## 318            No NA    NA NA NA NA
## 319           Yes NA    NA NA NA NA
## 320           Yes NA    NA NA NA NA
## 321           Yes NA    NA NA NA NA
## 322           Yes NA    NA NA NA NA
## 323            No NA    NA NA NA NA
## 324           Yes NA    NA NA NA NA
## 325            No NA    NA NA NA NA
## 326            No NA    NA NA NA NA
## 327           Yes NA    NA NA NA NA
## 328            No NA    NA NA NA NA
## 329           Yes NA    NA NA NA NA
## 330           Yes NA    NA NA NA NA
## 331            No NA    NA NA NA NA
## 332           Yes NA    NA NA NA NA
## 333           Yes NA    NA NA NA NA
## 334           Yes NA    NA NA NA NA
## 335           Yes NA    NA NA NA NA
## 336            No NA    NA NA NA NA
## 337            No NA    NA NA NA NA
## 338           Yes NA    NA NA NA NA
## 339           Yes NA    NA NA NA NA
## 340           Yes NA    NA NA NA NA
## 341            No NA    NA NA NA NA
## 342            No NA    NA NA NA NA
## 343            No NA    NA NA NA NA
## 344            No NA    NA NA NA NA
## 345           Yes NA    NA NA NA NA
## 346           Yes NA    NA NA NA NA
## 347           Yes NA    NA NA NA NA
## 348           Yes NA    NA NA NA NA
## 349           Yes NA    NA NA NA NA
## 350           Yes NA    NA NA NA NA
## 351            No NA    NA NA NA NA
## 352            No NA    NA NA NA NA
## 353            No NA    NA NA NA NA
## 354            No NA    NA NA NA NA
## 355           Yes NA    NA NA NA NA
## 356            No NA    NA NA NA NA
## 357            No NA    NA NA NA NA
```

```
## 358            No NA    NA NA NA NA
## 359            No NA    NA NA NA NA
## 360            No NA    NA NA NA NA
## 361            No NA    NA NA NA NA
## 362            No NA    NA NA NA NA
## 363           Yes NA    NA NA NA NA
## 364            No NA    NA NA NA NA
## 365           Yes NA    NA NA NA NA
## 366           Yes NA    NA NA NA NA
## 367            No NA    NA NA NA NA
## 368            No NA    NA NA NA NA
## 369           Yes NA    NA NA NA NA
## 370           Yes NA    NA NA NA NA
## 371           Yes NA    NA NA NA NA
## 372            No NA    NA NA NA NA
## 373            No NA    NA NA NA NA
## 374           Yes NA    NA NA NA NA
## 375           Yes NA    NA NA NA NA
## 376            No NA    NA NA NA NA
## 377           Yes NA    NA NA NA NA
## 378           Yes NA    NA NA NA NA
## 379           Yes NA    NA NA NA NA
## 380           Yes NA    NA NA NA NA
## 381           Yes NA    NA NA NA NA
## 382           Yes NA    NA NA NA NA
## 383           Yes NA    NA NA NA NA
## 384           Yes NA    NA NA NA NA
## 385           Yes NA    NA NA NA NA
## 386           Yes NA    NA NA NA NA
## 387            No NA    NA NA NA NA
## 388            No NA    NA NA NA NA
## 389           Yes NA    NA NA NA NA
## 390            No NA    NA NA NA NA
## 391           Yes NA    NA NA NA NA
## 392            No NA    NA NA NA NA
## 393           Yes NA    NA NA NA NA
## 394            No NA    NA NA NA NA
## 395           Yes NA    NA NA NA NA
## 396           Yes NA    NA NA NA NA
## 397           Yes NA    NA NA NA NA
## 398            No NA    NA NA NA NA
## 399            No NA    NA NA NA NA
## 400            No NA    NA NA NA NA
## 401           Yes NA    NA NA NA NA
## 402           Yes NA    NA NA NA NA
## 403            No NA    NA NA NA NA
## 404            No NA    NA NA NA NA
## 405            No NA    NA NA NA NA
## 406            No NA    NA NA NA NA
## 407           Yes NA    NA NA NA NA
## 408            No NA    NA NA NA NA
## 409            No NA    NA NA NA NA
## 410           Yes NA    NA NA NA NA
```

```
summary(Professional)
```

```
##       age           gender           real_estate         investments
##  Min.   :19.00   Length:410         Length:410         Min.   :     0
##  1st Qu.:28.00   Class :character   Class :character   1st Qu.: 18300
##  Median :30.00   Mode  :character   Mode  :character   Median : 24800
##  Mean   :30.11                                         Mean   : 28538
##  3rd Qu.:33.00                                         3rd Qu.: 34275
##  Max.   :42.00                                         Max.   :133400
##    num_trans      has_broadband          income       have_children
##  Min.   : 0.000   Length:410         Min.   : 16200   Length:410
##  1st Qu.: 4.000   Class :character   1st Qu.: 51625   Class :character
##  Median : 6.000   Mode  :character   Median : 66050   Mode  :character
##  Mean   : 5.973                      Mean   : 74460
##  3rd Qu.: 7.000                      3rd Qu.: 88775
##  Max.   :21.000                      Max.   :322500
##     NA                NA                 NA              NA              NA
##  Mode:logical   Length:410         Mode:logical   Mode:logical   Mode:logical
##  NA's:410       Class :character   NA's:410       NA's:410       NA's:410
##                 Mode  :character
##
##
##
##     NA
##  Mode:logical
##  NA's:410
##
##
##
##
```

```
#b. Develop 95% confidence intervals for the mean age and household income of subscribers.
# 95%  age
age_mean <- mean(Professional$age)
age_sd <- sd(Professional$age)
n <- length(Professional$age)
age_ci <- t.test(Professional$age)$conf.int
age_ci
```

```
## [1] 29.72153 30.50286
## attr(,"conf.level")
## [1] 0.95
```

```
# 95% income
income_mean <- mean(Professional$income)
income_sd <- sd(Professional$income)
income_ci <- t.test(Professional$income)$conf.int
income_ci
```

```
## [1] 71079.26 77839.77
## attr(,"conf.level")
## [1] 0.95
```

```
#c. Develop 95% confidence intervals for the proportion of subscribers who have broadband access at home and the proportion of subscribers who have children.
# 95% has_broadband
broadband_test <- prop.test(sum(Professional$has_broadband=="Yes"), length(Professional$has_broadband), conf.level = 0.95)
print(broadband_test)
```

```
##
##  1-sample proportions test with continuity correction
##
## data:  sum(Professional$has_broadband == "Yes") out of length(Professional$has_broadband), null probability 0.5
## X-squared = 24.88, df = 1, p-value = 6.1e-07
## alternative hypothesis: true p is not equal to 0.5
## 95 percent confidence interval:
##  0.5753252 0.6710862
## sample estimates:
##         p
## 0.6243902
```

```
# 95% have_children
children_test <- prop.test(sum(Professional$have_children=="Yes"), length(Professional$have_children), conf.level = 0.95)
print(children_test)
```

```
##
##  1-sample proportions test with continuity correction
##
## data:  sum(Professional$have_children == "Yes") out of length(Professional$have_children), null probability 0.5
## X-squared = 1.778, df = 1, p-value = 0.1824
## alternative hypothesis: true p is not equal to 0.5
## 95 percent confidence interval:
##  0.4845521 0.5830908
## sample estimates:
##         p
## 0.5341463
```

```
#d. Would Young Professional be a good advertising outlet for online brokers? Justify your conclusion with statistical data.
#yes real_estate>0.5
real_estate <- sum(Professional$real_estate=="Yes")/length(Professional$real_estate)
real_estate
```

```
## [1] 0.4414634
```

```
#e. Would this magazine be a good place to advertise for companies selling educational sof
tware and computer games for young children?
# yes,have_children>0.5
have_children <- sum(Professional$have_children=="Yes")/length(Professional$have_children)
have_children
```

```
## [1] 0.5341463
```

```
#f. Comment on the types of articles you believe would be of interest to readers of Young
Professional.

# eg:children estate
```

Question #5: Quality Associate, Inc. (Attached Data: Quality)

```
Quality <- read.csv("data/Quality.csv", header = TRUE, sep = ",")
# a. Conduct a hypothesis test for each sample at the .01 level of significance and determ
ine what action, if any, should be taken. Provide the p-value for each test.
alpha <- 0.01
t_test_results <- lapply(Quality[, 1:4], function(x) t.test(x, mu = 12, var.equal = TRUE))
p_values <- sapply(t_test_results, function(test) test$p.value)
names(p_values) <- c("Sample 1", "Sample 2", "Sample 3", "Sample 4")
p_values
```

```
##    Sample 1    Sample 2    Sample 3    Sample 4
## 0.312729582 0.481820940 0.006468822 0.039058947
```

```
# b. compute the standard deviation for each of the four samples. does the assumption of .
21 for the population standard deviation appear reasonable?
# is reasonable
sample_sds <- sapply(Quality[, 1:4], sd)
names(sample_sds) <- c("Sample 1", "Sample 2", "Sample 3", "Sample 4")
sample_sds
```

```
##  Sample 1  Sample 2  Sample 3  Sample 4
## 0.2203560 0.2203560 0.2071706 0.2061090
```

```
# c. compute limits for the sample mean x around miu= 12 such that, as long as a new sampl
e mean is within those limits, the process will be considered to be operating satisfactori
ly. if x exceeds the upper limit or if x is below the lower limit, corrective action will
be taken. these limits are referred to as upper and lower control limits for quality contr
ol purposes.
miu = 12
sigma = 0.21
n = 30
alpht = 0.01
zinterval <- function(miu,sigma,prob,n) {
  return(c(miu + qnorm(prob) * sigma / sqrt(n),
           miu - qnorm(prob) * sigma / sqrt(n)))}
zinterval(12,0.21,0.01,30)
```

```
## [1] 11.91081 12.08919
```

```
# d. discuss the implications of changing the level of significance to a larger value. wha
t mistake or error could increase if the level of significance is increased?
#Type I error will increase
zinterval(12,0.21,0.05,30)
```

```
## [1] 11.93694 12.06306
```

```
#Type I error: The probability of incorrectly rejecting the true null hypothesis increases
. This can lead to unnecessary corrective actions.
#Type II error: The probability of incorrectly failing to reject a false null hypothesis i
s reduced because it is easier to reject the null hypothesis.
```

Question #6: Vacation occupancy rates were expected to be up during March 2008 in Myrtle

Beach, South Carolina (the sun news, February 29, 2008). Data in the file Occupancy (Attached file Occupancy) will allow you to replicate the findings presented in the newspaper. The data show units rented and not rented for a random sample of vacation properties during the first week of March 2007 and March 2008.

```
Occupancy <- read.csv("data/Occupancy.csv", skip = 1)
Occupancy
```

```
##    March.2007 March.2008
## 1         Yes         No
## 2          No        Yes
## 3         Yes        Yes
## 4          No         No
## 5          No        Yes
## 6         Yes         No
## 7          No         No
## 8          No        Yes
## 9          No        Yes
## 10        Yes        Yes
## 11         No         No
## 12        Yes         No
## 13         No        Yes
## 14         No        Yes
## 15         No        Yes
## 16         No        Yes
## 17         No         No
## 18         No        Yes
## 19         No        Yes
## 20         No        Yes
## 21         No        Yes
## 22         No         No
## 23        Yes        Yes
## 24        Yes         No
## 25        Yes        Yes
## 26        Yes         No
## 27         No        Yes
## 28        Yes         No
## 29         No         No
## 30         No         No
## 31         No        Yes
## 32        Yes        Yes
## 33         No         No
## 34        Yes        Yes
## 35         No         No
## 36        Yes         No
## 37         No        Yes
## 38        Yes        Yes
## 39        Yes         No
## 40         No         No
## 41         No        Yes
## 42        Yes        Yes
## 43         No         No
## 44         No        Yes
## 45        Yes         No
## 46        Yes         No
## 47         No        Yes
## 48         No        Yes
## 49         No        Yes
## 50         No        Yes
## 51         No         No
## 52         No         No
## 53        Yes         No
```

```
## 54          No         No
## 55          No        Yes
## 56          No         No
## 57          No         No
## 58          No         No
## 59         Yes         No
## 60          No        Yes
## 61         Yes         No
## 62          No        Yes
## 63          No        Yes
## 64         Yes         No
## 65          No         No
## 66          No         No
## 67          No         No
## 68         Yes         No
## 69          No        Yes
## 70          No         No
## 71         Yes         No
## 72         Yes         No
## 73         Yes         No
## 74          No         No
## 75          No        Yes
## 76          No        Yes
## 77         Yes        Yes
## 78          No         No
## 79          No         No
## 80          No        Yes
## 81          No        Yes
## 82          No        Yes
## 83         Yes         No
## 84          No         No
## 85         Yes        Yes
## 86          No         No
## 87         Yes        Yes
## 88          No         No
## 89         Yes         No
## 90          No        Yes
## 91          No        Yes
## 92          No        Yes
## 93         Yes        Yes
## 94          No        Yes
## 95          No        Yes
## 96         Yes        Yes
## 97          No        Yes
## 98          No        Yes
## 99          No         No
## 100         No         No
## 101        Yes        Yes
## 102         No         No
## 103        Yes        Yes
## 104        Yes         No
## 105        Yes         No
## 106         No         No
## 107         No         No
## 108        Yes        Yes
```

```
## 109          No        Yes
## 110         Yes         No
## 111         Yes        Yes
## 112         Yes         No
## 113          No         No
## 114         Yes        Yes
## 115          No         No
## 116         Yes         No
## 117          No         No
## 118         Yes         No
## 119         Yes         No
## 120          No         No
## 121          No         No
## 122          No         No
## 123          No         No
## 124          No        Yes
## 125          No        Yes
## 126          No         No
## 127          No        Yes
## 128          No         No
## 129         Yes         No
## 130         Yes         No
## 131         Yes        Yes
## 132          No         No
## 133          No        Yes
## 134          No        Yes
## 135         Yes         No
## 136          No        Yes
## 137          No         No
## 138         Yes         No
## 139         Yes         No
## 140          No         No
## 141         Yes        Yes
## 142         Yes        Yes
## 143          No        Yes
## 144         Yes         No
## 145          No        Yes
## 146         Yes        Yes
## 147          No        Yes
## 148         Yes         No
## 149         Yes         No
## 150          No         No
## 151          No
## 152          No
## 153         Yes
## 154          No
## 155          No
## 156          No
## 157          No
## 158          No
## 159          No
## 160          No
## 161          No
## 162          No
## 163         Yes
```

```
## 164        Yes
## 165         No
## 166         No
## 167         No
## 168        Yes
## 169         No
## 170         No
## 171         No
## 172         No
## 173         No
## 174         No
## 175         No
## 176        Yes
## 177        Yes
## 178         No
## 179         No
## 180        Yes
## 181         No
## 182         No
## 183        Yes
## 184         No
## 185        Yes
## 186         No
## 187         No
## 188        Yes
## 189        Yes
## 190         No
## 191         No
## 192         No
## 193         No
## 194         No
## 195        Yes
## 196        Yes
## 197         No
## 198         No
## 199         No
## 200         No
```

```
#a. Estimate the proportion of units rented during the first week of March 2007 and the fi
rst week of March 2008.
#sum(Occupancy$March.2007 %in% c("Yes"))/200
#sum(Occupancy$March.2008 %in% c("Yes"))/150
rented2007 <- sum(Occupancy$March.2007=="Yes")/length(Occupancy$March.2007)
rented2007
```

```
## [1] 0.35
```

```
rented2008 <- sum(Occupancy$March.2008=="Yes")/150
rented2008
```

```
## [1] 0.4666667
```

```
# b. Provide a 95% confidence interval for the difference in proportions.
pa <- sum(Occupancy$March.2007 %in% c("Yes"))/200
pb <- sum(Occupancy$March.2008 %in% c("Yes"))/150
e <- qnorm(0.975) * sqrt(pa*(1-pa)/200 + pb*(1-pb)/150)
c(pa-pb-e,pa-pb+e)
```

```
## [1] -0.22031818 -0.01301516
```

```
# c. On the basis of your findings, does it appear March rental rates for 2008 will be up
from those a year earlier?
# -0.22031818 -0.01301516 doesn't include Zero,Impossible to judge
```

Question #7: Air Force Training Program (data file: Training)

```
Training <- read.csv("data/Training.csv", header = TRUE, sep = ",")
Training
```

```
##    Current Proposed
## 1       76       74
## 2       76       75
## 3       77       77
## 4       74       78
## 5       76       74
## 6       74       80
## 7       74       73
## 8       77       73
## 9       72       78
## 10      78       76
## 11      73       76
## 12      78       74
## 13      75       77
## 14      80       69
## 15      79       76
## 16      72       75
## 17      69       72
## 18      79       75
## 19      72       72
## 20      70       76
## 21      70       72
## 22      81       77
## 23      76       73
## 24      78       77
## 25      72       69
## 26      82       77
## 27      72       75
## 28      73       76
## 29      71       74
## 30      70       77
## 31      77       75
## 32      78       78
## 33      73       72
## 34      79       77
## 35      82       78
## 36      65       78
## 37      77       76
## 38      79       75
## 39      73       76
## 40      76       76
## 41      81       75
## 42      69       76
## 43      75       80
## 44      75       77
## 45      77       76
## 46      79       75
## 47      76       73
## 48      78       77
## 49      76       77
## 50      76       77
## 51      73       79
## 52      77       75
## 53      84       75
```

```
## 54      74       72
## 55      74       82
## 56      69       76
## 57      79       76
## 58      66       74
## 59      70       72
## 60      74       78
## 61      72       71
```

```
#a. use appropriate descriptive statistics to summarize the training time data for each me
thod.what similarities or differences do you observe from the sample data?
skimr::skim(Training)
```

Data summary

Name	Training
Number of rows	61
Number of columns	2
_______________________	
Column type frequency:	
numeric	2
________________________	
Group variables	None

Variable type: numeric

skim_variable	n_missing	complete_rate	mean	sd	p0	p25	p50	p75	p100	hist
Current	0	1	75.07	3.94	65	72	76	78	84	▁▅▇▆▂
Proposed	0	1	75.43	2.51	69	74	76	77	82	▁▆▇▆▁

```
summary(Training$Current)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   65.00   72.00   76.00   75.07   78.00   84.00
```

```
summary(Training$Proposed)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   69.00   74.00   76.00   75.43   77.00   82.00
```

```
#b. Comment on any difference between the population means for the two methods. Discuss yo
ur findings.
Current <- mean(Training$Current)
Current
```

```
## [1] 75.06557
```

```
Proposed <- mean(Training$Proposed)
Proposed
```

```
## [1] 75.42623
```

```
#t.test(Training$Current,Training$Proposed)
# Proposed is Bigger

# c. compute the standard deviation and variance for each training method. conduct a hypot
hesis test about the equality of population variances for the two training methods. Discus
s your findings.

sdCurrent <- sd(Training$Current)
varCurrent <- var(Training$Current)
sdProposed <- sd(Training$Proposed)
varProposed <- var(Training$Proposed)
sdCurrent
```

```
## [1] 3.944907
```

```
varCurrent
```

```
## [1] 15.5623
```

```
sdProposed
```

```
## [1] 2.506385
```

```
varProposed
```

```
## [1] 6.281967
```

```
# 方差相等性检验（F-test）
vartest <- var.test(Training$Current, Training$Proposed)
vartest
```

```
##
##  F test to compare two variances
##
## data:  Training$Current and Training$Proposed
## F = 2.4773, num df = 60, denom df = 60, p-value = 0.000578
## alternative hypothesis: true ratio of variances is not equal to 1
## 95 percent confidence interval:
##  1.486267 4.129135
## sample estimates:
## ratio of variances
##           2.477296
```

```
# d. what conclusion can you reach about any differences between the two methods? what is your recommendation? explain.
if (Proposed < Current && vartest$p.value > 0.05) {
  cat("The current method is preferred\n")
} else {
  cat("The proposed method is preferred\n")
}
```

```
## The proposed method is preferred
```

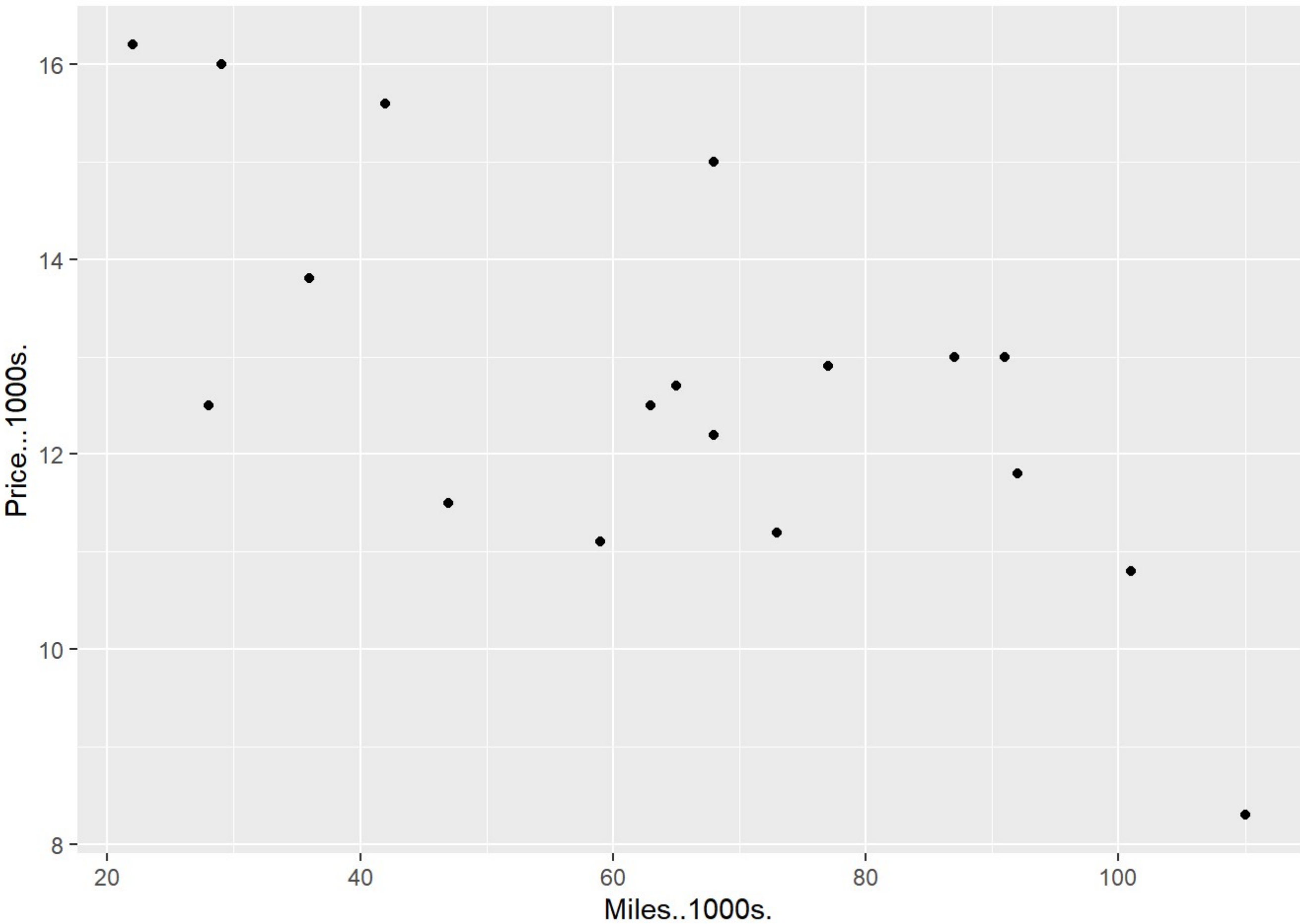
```
#e. can you suggest other data or testing that might be desirable before making a final decision on the training program to be used in the future
# such as student satisfaction
```

Question #8: The Toyota Camry is one of the best-selling cars in North America. The cost of a previously owned Camry depends upon many factors, including the model year, mileage, and condition. To investigate the relationship between the car's mileage and the sales price for a 2007 model year Camry, Attached data file Camry show the mileage and sale price for 19 sales (Pricehub website, February 24, 2012).

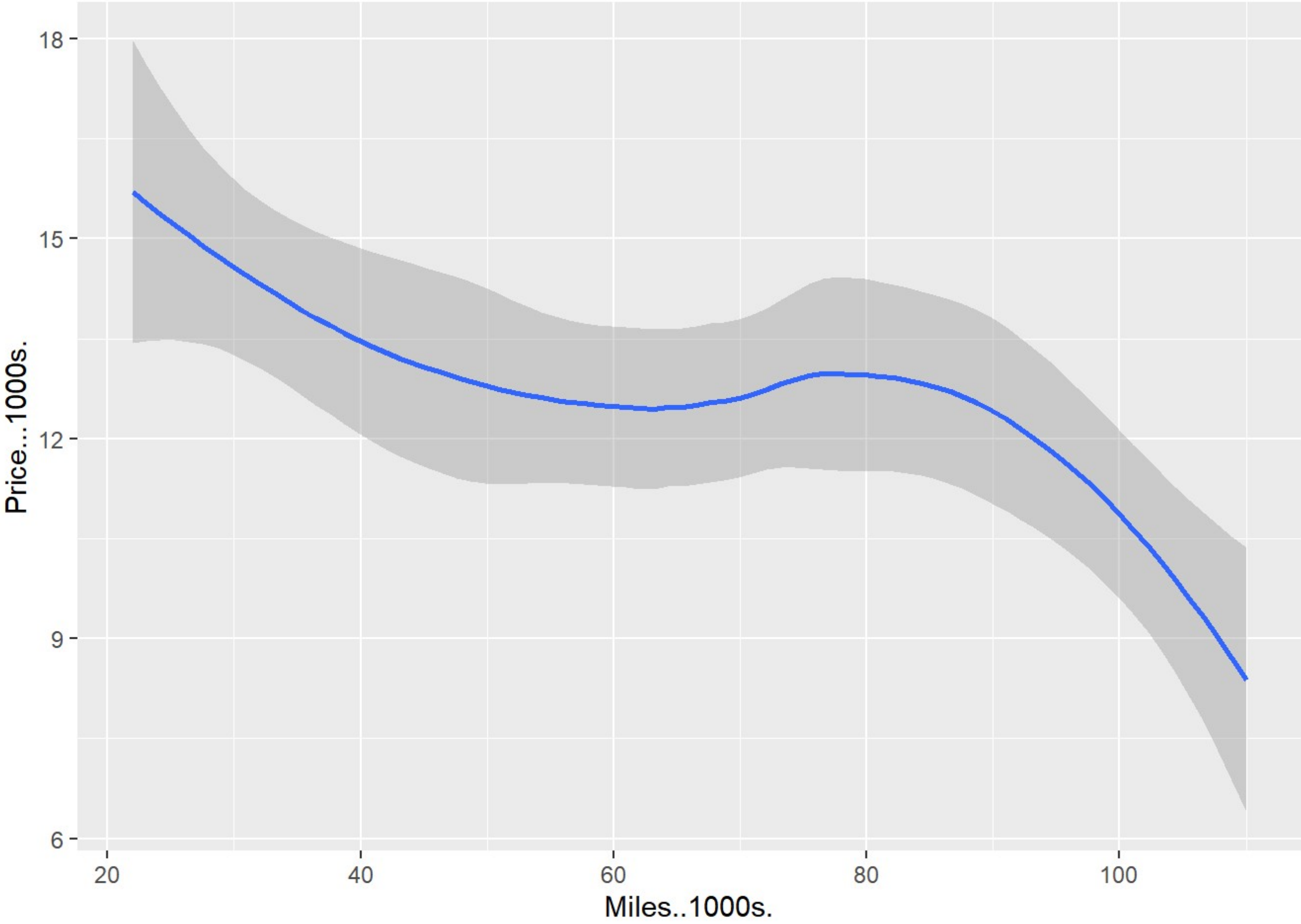
```
Camry <- read.csv("data/Camry.csv", header = TRUE, sep = ",")
Camry
```

```
##    Miles..1000s. Price...1000s.
## 1             22           16.2
## 2             29           16.0
## 3             36           13.8
## 4             47           11.5
## 5             63           12.5
## 6             77           12.9
## 7             73           11.2
## 8             87           13.0
## 9             92           11.8
## 10           101           10.8
## 11           110            8.3
## 12            28           12.5
## 13            59           11.1
## 14            68           15.0
## 15            68           12.2
## 16            91           13.0
## 17            42           15.6
## 18            65           12.7
## 19           110            8.3
```

```
#a. Develop a scatter diagram with the car mileage on the horizontal axis and the price on
the vertical axis.
ggplot(Camry, aes(Miles..1000s., Price...1000s.)) +
  geom_point()
```



```
# b. what does the scatter diagram developed in part (a) indicate about the relationship b
etween the two variables?
ggplot(Camry, aes(Miles..1000s., Price...1000s.)) +
  geom_smooth(method = 'loess',formula = 'y ~ x')
```




```
# decrease
# c. Develop the estimated regression equation that could be used to predict the price ($1
000s) given the miles (1000s).
lm_camry <- lm(Price...1000s.~ Miles..1000s., data = Camry)
summary(lm_camry)
```

```
##
## Call:
## lm(formula = Price...1000s. ~ Miles..1000s., data = Camry)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -2.32408 -1.34194  0.05055  1.12898  2.52687
##
## Coefficients:
##               Estimate Std. Error t value Pr(>|t|)
## (Intercept)   16.46976    0.94876  17.359 2.99e-12 ***
## Miles..1000s. -0.05877    0.01319  -4.455 0.000348 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.541 on 17 degrees of freedom
## Multiple R-squared:  0.5387, Adjusted R-squared:  0.5115
## F-statistic: 19.85 on 1 and 17 DF,  p-value: 0.0003475
```

```
# d. Test for a significant relationship at the .05 level of significance.

#p-value = 0.0003475<0.05

# e. Did the estimated regression equation provide a good fit? Explain.

# R-squared:  0.5387 good fig

# f. Provide an interpretation for the slope of the estimated regression equation.

# estimated -0.05877  Miles increase Price decrease

# g. Suppose that you are considering purchasing a previously owned 2007 Camry that has be
en driven 60,000 miles. Using the estimated regression equation developed in part (c), pre
dict the price for this car. Is this the price you would offer the seller.

# Price = 16.470 - 0.059 * miles  12942
```

Question #9

```
WE <- read_excel("data/WE.xlsx") %>%
  set_names("id","churn","happy_index","chg_hi","support","chg_supprt",
            "priority","chg_priority","log_in_fre","chg_blog_fre","chg_vis","y_age","chg_i
nterval")
list_name = c("id","churn","happy_index","chg_hi","support","chg_supprt",
            "priority","chg_priority","log_in_fre","chg_blog_fre","chg_vis","y_age","chg_i
nterval")
WE
```

```
## # A tibble: 6,347 × 13
##       id churn happy_index chg_hi support chg_supprt priority chg_priority
##    <dbl> <dbl>       <dbl>  <dbl>   <dbl>      <dbl>    <dbl>        <dbl>
##  1     1     0           0      0       0          0        0            0
##  2     2     0          62      4       0          0        0            0
##  3     3     0           0      0       0          0        0            0
##  4     4     0         231      1       1         -1        3            0
##  5     5     0          43     -1       0          0        0            0
##  6     6     0         138    -10       0          0        0            0
##  7     7     0         180     -5       1          1        3            3
##  8     8     0         116    -11       0          0        0            0
##  9     9     0          78     -7       1         -2        3            0
## 10    10     0          78    -37       0          0        0            0
## # ℹ 6,337 more rows
## # ℹ 5 more variables: log_in_fre <dbl>, chg_blog_fre <dbl>, chg_vis <dbl>,
## #   y_age <dbl>, chg_interval <dbl>
```

```
#a
WE %>%
  select(-id) %>%
  group_by(churn) %>%
  group_modify(~{
    .x %>%
      purrr::map_dfc(mean, na.rm = TRUE)
  }) %>%
  ungroup()
```

```
## # A tibble: 2 × 12
##   churn happy_index chg_hi support chg_supprt priority chg_priority log_in_fre
##   <dbl>       <dbl>  <dbl>   <dbl>      <dbl>    <dbl>        <dbl>      <dbl>
## 1     0        88.6   5.53   0.724   -0.00930    0.830       0.0327      16.1
## 2     1        63.3  -3.74   0.372    0.0372     0.500      -0.0167       8.06
## # ℹ 4 more variables: chg_blog_fre <dbl>, chg_vis <dbl>, y_age <dbl>,
## #   chg_interval <dbl>
```

```
#b.
compare_means <- function(var_name) {
  group_0 <- WE[WE$churn == 0, var_name]
  group_1 <- WE[WE$churn == 1, var_name]
  result <- t.test(group_0, group_1)
  return(result)
}

for(i in 3:length(list_name)){
  print(list_name[i])
  print(compare_means(list_name[i]))
}
```

```
## [1] "happy_index"
## 
##  Welch Two Sample t-test
## 
## data:  group_0 and group_1
## t = 7.6242, df = 369.36, p-value = 2.097e-13
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  18.79956 31.86737
## sample estimates:
## mean of x mean of y 
##  88.60591  63.27245 
## 
## [1] "chg_hi"
## 
##  Welch Two Sample t-test
## 
## data:  group_0 and group_1
## t = 5.7835, df = 365.71, p-value = 1.571e-08
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##   6.116137 12.417972
## sample estimates:
## mean of x mean of y 
##  5.530212 -3.736842 
## 
## [1] "support"
## 
##  Welch Two Sample t-test
## 
## data:  group_0 and group_1
## t = 5.5099, df = 419.22, p-value = 6.281e-08
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  0.2269082 0.4785969
## sample estimates:
## mean of x mean of y 
## 0.7242696 0.3715170 
## 
## [1] "chg_supprt"
## 
##  Welch Two Sample t-test
## 
## data:  group_0 and group_1
## t = -0.63198, df = 406.9, p-value = 0.5278
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -0.19092606  0.09803036
## sample estimates:
##    mean of x    mean of y 
## -0.009296149  0.037151703 
## 
## [1] "priority"
## 
```

```
##  Welch Two Sample t-test
##
## data:  group_0 and group_1
## t = 5.1428, df = 373.13, p-value = 4.381e-07
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  0.2038355 0.4562009
## sample estimates:
## mean of x mean of y
## 0.8295759 0.4995577
##
## [1] "chg_priority"
##
##  Welch Two Sample t-test
##
## data:  group_0 and group_1
## t = 0.64116, df = 364.49, p-value = 0.5218
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -0.1020692  0.2008252
## sample estimates:
##   mean of x   mean of y
##  0.03268184 -0.01669615
##
## [1] "log_in_fre"
##
##  Welch Two Sample t-test
##
## data:  group_0 and group_1
## t = 3.5709, df = 362.67, p-value = 0.0004037
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##   3.628884 12.525166
## sample estimates:
## mean of x mean of y
##  16.13894   8.06192
##
## [1] "chg_blog_fre"
##
##  Welch Two Sample t-test
##
## data:  group_0 and group_1
## t = 2.5315, df = 695.95, p-value = 0.01158
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  0.06133902 0.48529282
## sample estimates:
##  mean of x  mean of y
##  0.1711487 -0.1021672
##
## [1] "chg_vis"
##
##  Welch Two Sample t-test
##
## data:  group_0 and group_1
```

```
## t = 1.9136, df = 448, p-value = 0.05631
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##   -5.463729 410.218457
## sample estimates:
## mean of x mean of y
##  106.6096  -95.7678
##
## [1] "y_age"
##
##  Welch Two Sample t-test
##
## data:  group_0 and group_1
## t = -2.9811, df = 379.9, p-value = 0.003057
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -2.5461200 -0.5223121
## sample estimates:
## mean of x mean of y
##  18.81873  20.35294
##
## [1] "chg_interval"
##
##  Welch Two Sample t-test
##
## data:  group_0 and group_1
## t = -4.0971, df = 346.03, p-value = 5.215e-05
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -7.362712 -2.586515
## sample estimates:
## mean of x mean of y
##  3.511454  8.486068
```

```
#c.

model_q9 <- glm(churn ~., data = WE[, c("churn", list_name)], family = binomial())
summary(model_q9)
```

```
##
## Call:
## glm(formula = churn ~ ., family = binomial(), data = WE[, c("churn",
##     list_name)])
##
## Coefficients:
##                Estimate Std. Error z value Pr(>|z|)
## (Intercept)  -7.529e-01  2.275e-01  -3.309 0.000935 ***
## id           -4.102e-04  3.991e-05 -10.279  < 2e-16 ***
## happy_index  -7.710e-03  1.250e-03  -6.166    7e-10 ***
## chg_hi       -7.057e-03  2.532e-03  -2.787 0.005317 **
## support      -1.098e-01  1.032e-01  -1.064 0.287402
## chg_supprt    1.297e-01  8.958e-02   1.447 0.147803
## priority      3.486e-04  1.018e-01   0.003 0.997267
## chg_priority -3.007e-02  7.801e-02  -0.385 0.699910
## log_in_fre    5.686e-04  2.209e-03   0.257 0.796865
## chg_blog_fre  3.361e-03  2.086e-02   0.161 0.872005
## chg_vis      -9.431e-05  4.223e-05  -2.233 0.025547 *
## y_age        -2.324e-02  6.495e-03  -3.579 0.000346 ***
## chg_interval  1.075e-02  3.686e-03   2.916 0.003542 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 2553.1  on 6346  degrees of freedom
## Residual deviance: 2341.6  on 6334  degrees of freedom
## AIC: 2367.6
##
## Number of Fisher Scoring iterations: 7
```

```
# d
not_churned_data <- WE[WE$churn == 1, ]

probabilities_q9 <- predict(model_q9, newdata = not_churned_data, type = "response")
not_churned_data$Loss_probability <- probabilities_q9
sorted_data <- not_churned_data[order(not_churned_data$Loss_probability), ]

top_100_user_ids <- sorted_data$id[1:100]
print(top_100_user_ids)
```

```
##   [1] 5294 2704 5271 4455 4740 3984 4817 5560 4899 4793 4178 5587   54 4642 1892
##  [16] 5350 5422 4239 4137 5765 4055 4299 4489 1764 3849 2869 4925 4174 3005 2980
##  [31] 3134 4900 4313 2578 2212 1037 2506 3558 1641 3670 4006 3494 5405 3806 4058
##  [46] 5214 3135 6263 1810 2682 3626 6127 2073 3876 3064 3886 2249 3492 3014 3069
##  [61] 1489 4363 2941 4483 1339 1997 4885 2701 3779  978 2650 2616 1043 4459 3682
##  [76] 1895 2357 4185 4629 1067  886 1905 2011 4157 1551 1992 2693 3256 1947 1872
##  [91] 5426 2628  875 4582 2489 4020 1724 4533 5052  153
```