practice_exercise

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#Reading the dataset

```
practice_data = read_excel("./data/Practice_exercise.xlsx", sheet = "Data") %>%
  janitor::clean_names() %>%
  select(observation_number,quarter,employee_id, sex = sex_male_1, race, age, hospital_visit = hospital_
  mutate(
    age_cat = case_when(
      age < 30 ~ 1,
      age <= 45 ~ 2,
      age > 45 ~ 3
    )
  )
```

#Checking for missing data

```
sapply(practice_data, function(x) sum(is.na(x)))
```

```
## observation_number            quarter        employee_id
##                  0                  0                  0
##                sex               race                age
##                 71               2123                  0
##     hospital_visit             salary       health_score
##                  0                  0                  0
##            age_cat
##                  0
```

```
practice_data %>%
  select(everything()) %>%
  summarise_all(funs(sum(is.na(.))))
```

```
## # A tibble: 1 x 10
##   observation_num~ quarter employee_id   sex  race   age hospital_visit
##              <int>   <int>       <int> <int> <int> <int>          <int>
## 1                0       0           0    71  2123     0              0
## # ... with 3 more variables: salary <int>, health_score <int>,
## #   age_cat <int>
```

#Finding the minimum and maximum values of each variable

```
sapply(practice_data, function(x) min(x))
```

```
## observation_number            quarter        employee_id
##       1.000000e+00       1.000000e+00       1.000000e+00
##                sex               race                age
```

```
##                  NA                  NA       7.000000e+00
##     hospital_visit              salary       health_score
##       0.000000e+00       2.835070e+04       6.265991e-01
##            age_cat
##       1.000000e+00
```

```
sapply(practice_data, function(x) max(x))
```

```
## observation_number            quarter        employee_id
##           19103.00              12.00            2000.00
##                sex               race                age
##                 NA                 NA             172.00
##     hospital_visit             salary       health_score
##               1.00           68826.34              10.00
##            age_cat
##               3.00
```

#Checking the number of employees with health score outside the range of data

```
practice_data %>%
  count(
   health_sc_6 = ifelse(health_score > 6, 1, 0)
  )
```

```
## # A tibble: 2 x 2
##   health_sc_6     n
##         <dbl> <int>
## 1           0 17865
## 2           1  1238
```

#Calculating the number of quarters for which the employees have missing data on sex

```
practice_data %>%
  select(
    employee_id, sex
  ) %>%
  filter(
  is.na(sex)
  ) %>%
  group_by(
    employee_id
  ) %>%
  summarise(
    missing = sum(is.na(sex))
  )
```

```
## # A tibble: 7 x 2
##   employee_id missing
##         <dbl>   <int>
## 1        1994      10
## 2        1995       9
## 3        1996      12
```

```
## 4         1997       11
## 5         1998       12
## 6         1999        7
## 7         2000       10
```

#Calculating the number of quarters for which the employees have missing data on race

```
practice_data %>%
  select(
    employee_id, race
  ) %>%
  filter(
     is.na(race)
  ) %>%
  group_by(
    employee_id
  ) %>%
  summarise(
    miss = sum(is.na(race))
  )
```

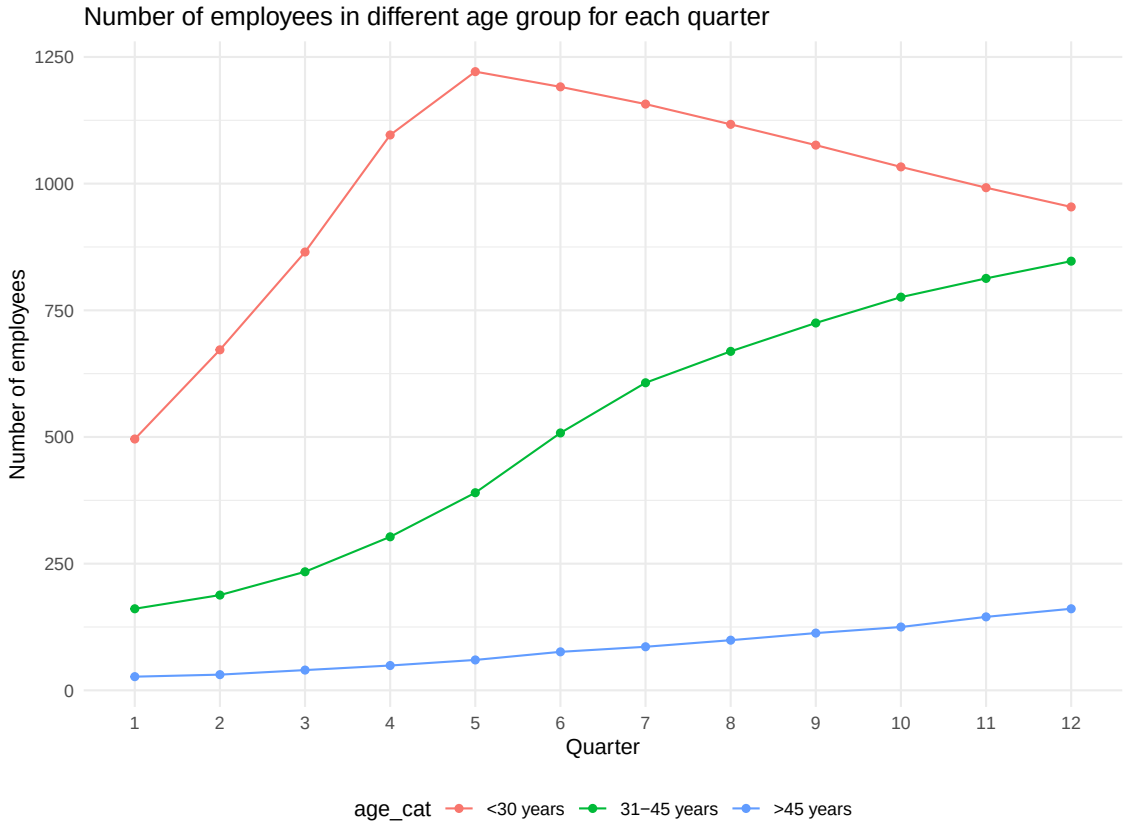
```
## # A tibble: 220 x 2
##    employee_id  miss
##          <dbl> <int>
##  1           8    10
##  2          10    12
##  3          13     9
##  4          22     9
##  5          36    12
##  6          38    12
##  7          48    10
##  8          49     7
##  9          51     8
## 10          55     9
## # ... with 210 more rows
```

#Calculating the number of employees in each age group for each quarter

```
emp_data = practice_data %>%
  mutate(
    quarter = factor(
    quarter),
    age_cat = factor(age_cat)
  )
```

```
emp_data = emp_data %>%
  select(
    employee_id, quarter, age_cat
  ) %>%
  group_by(
    quarter, age_cat
  ) %>%
  tally()
```

```
e <- ggplot(emp_data, aes(x = quarter, y = n, group = age_cat)) +
  geom_line(aes(color = age_cat)) +
  geom_point(aes(color = age_cat)) + labs(x = "Quarter", y = "Number of employees", title = "Number of
e
```



#Checking the trend in average salary over time

```
practice_data %>%
  select(
    salary, quarter
  ) %>%
  group_by(
    quarter
  ) %>%
  summarise(
    avg_salary = mean(salary)
  )
```

```
## # A tibble: 12 x 2
##    quarter avg_salary
##      <dbl>      <dbl>
##  1       1     43628.
##  2       2     44274.
##  3       3     45021.
##  4       4     45531.
##  5       5     46133.
##  6       6     46948.
```

```
##  7       7     47780.
##  8       8     48667.
##  9       9     49562.
## 10      10     50498.
## 11      11     51433.
## 12      12     52376.
```

```
salary_data = practice_data %>%
  mutate(
    age_cat = factor(age_cat),
quarter = factor(quarter))
```

#Checking the trend in average salary over time by age group

```
salary_data = salary_data %>%
  select(
    salary, quarter, age_cat
  ) %>%
  group_by(
    quarter, age_cat
  ) %>%
  summarise(
    avg_salary = mean(salary)
  )
```

```
p <- ggplot(salary_data, aes(x = quarter, y = avg_salary, group = age_cat)) +
  geom_line(aes(color = age_cat)) +
  geom_point(aes(color = age_cat)) + labs(x = "Quarter", y = "Average Salary", title = "Trend in averag
p
```

#Checking the trend in mean health score over time

```
hc = practice_data %>%
  select(
    health_score, quarter
  ) %>%
  group_by(
    quarter
  ) %>%
  summarise(
    avg_score = mean(health_score)
  )
```

#Mean health score over time by age group

```
practice_data %>%
  select(
    health_score, quarter, age_cat
  ) %>%
  group_by(
    quarter, age_cat
  ) %>%
  summarise(
    avg_score = mean(health_score)
  )
```

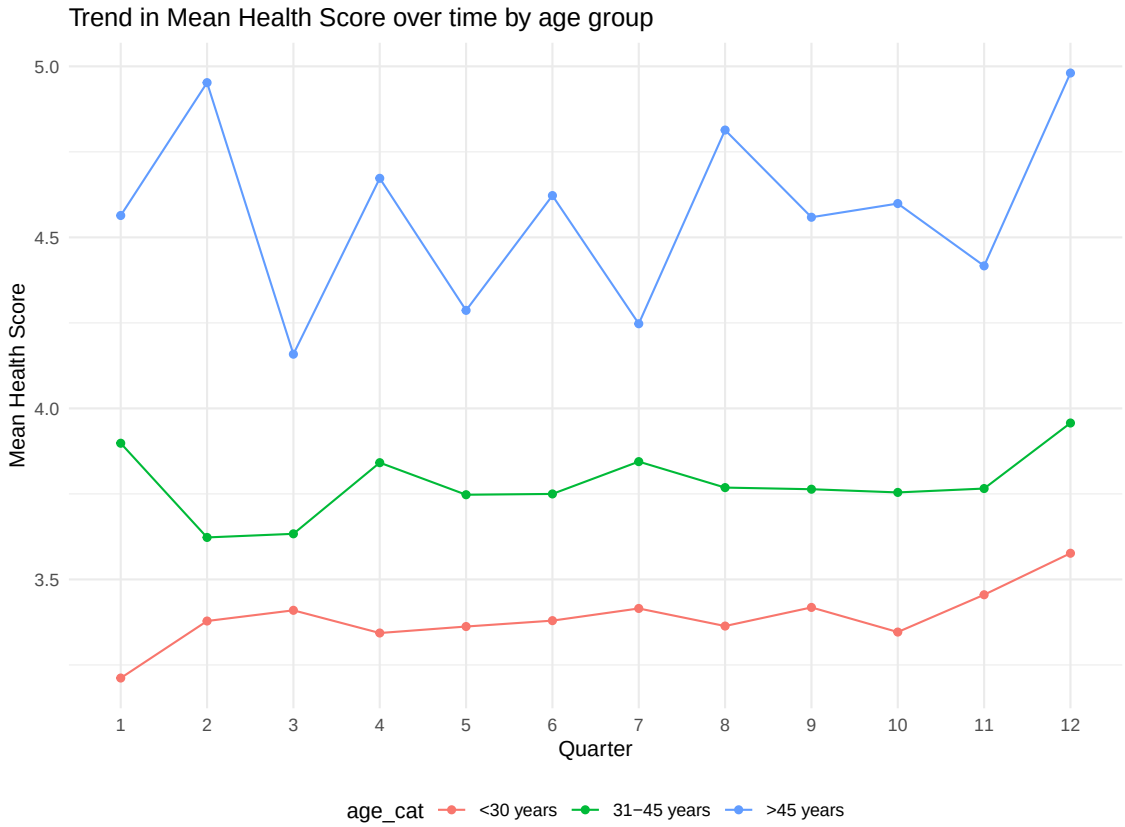
```
## # A tibble: 36 x 3
```

```
## # Groups:   quarter [12]
##    quarter age_cat avg_score
##      <dbl>   <dbl>     <dbl>
##  1       1       1      3.21
##  2       1       2      3.90
##  3       1       3      4.56
##  4       2       1      3.38
##  5       2       2      3.62
##  6       2       3      4.95
##  7       3       1      3.41
##  8       3       2      3.63
##  9       3       3      4.16
## 10       4       1      3.34
## # ... with 26 more rows
```

```
health_sc = practice_data %>%
  mutate(
    age_cat = factor(age_cat),
quarter = factor(quarter))
```

```
health_sc = health_sc %>%
  select(
    health_score, quarter, age_cat
  ) %>%
  group_by(
    quarter, age_cat
  ) %>%
  summarise(
    avg_score = mean(health_score)
  )
```

```
p1 <- ggplot(health_sc, aes(x = quarter, y = avg_score, group = age_cat)) +
  geom_line(aes(color = age_cat)) +
  geom_point(aes(color = age_cat)) + labs(x = "Quarter", y = "Mean Health Score", title = "Trend in Mea
p1
```

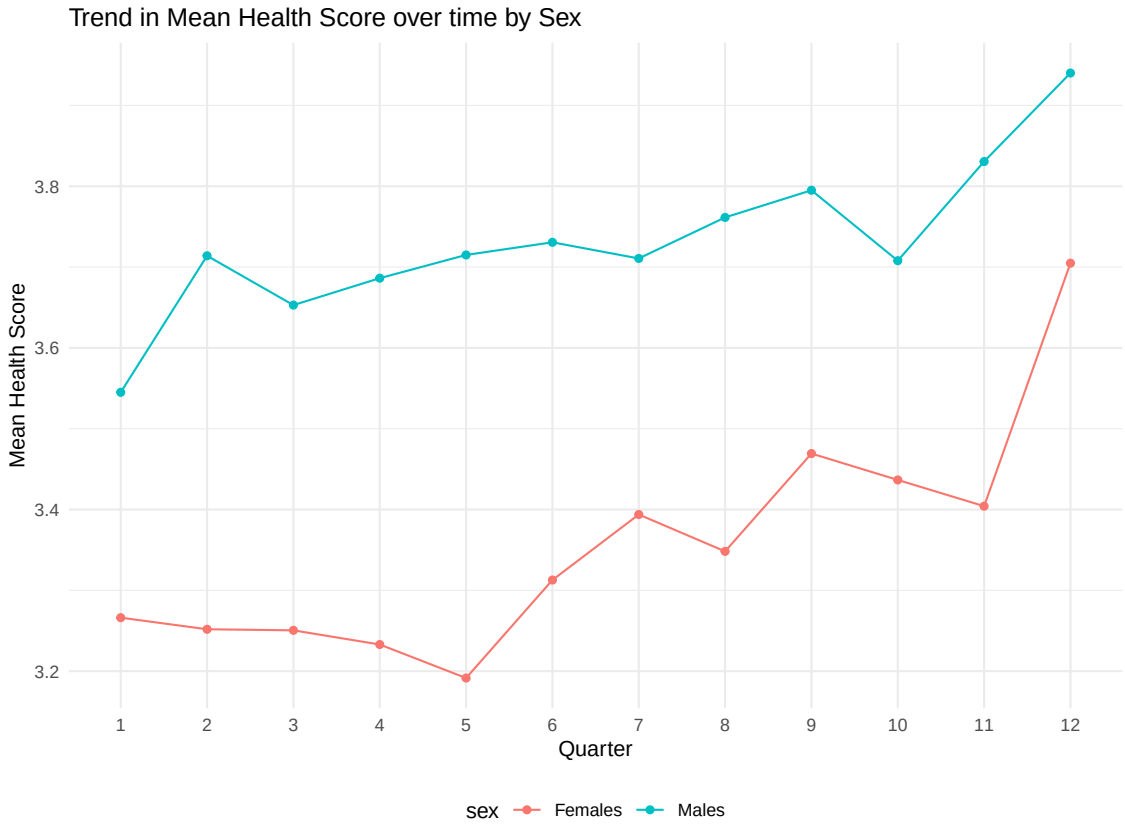


#Mean health score over time by sex

```
health_sex = practice_data %>%
  mutate(
    sex = factor(sex),
quarter = factor(quarter))
```

```
health_sex = health_sex %>%
  drop_na() %>%
  select(
    health_score, quarter, sex
  ) %>%
  group_by(
    quarter, sex
  ) %>%
  summarise(
    avg_score = mean(health_score)
  )
```

```
pq <- ggplot(health_sex, aes(x = quarter, y = avg_score, group = sex)) +
  geom_line(aes(color = sex)) +
  geom_point(aes(color = sex)) + labs(x = "Quarter", y = "Mean Health Score", title = "Trend in Mean Hea
pq
```

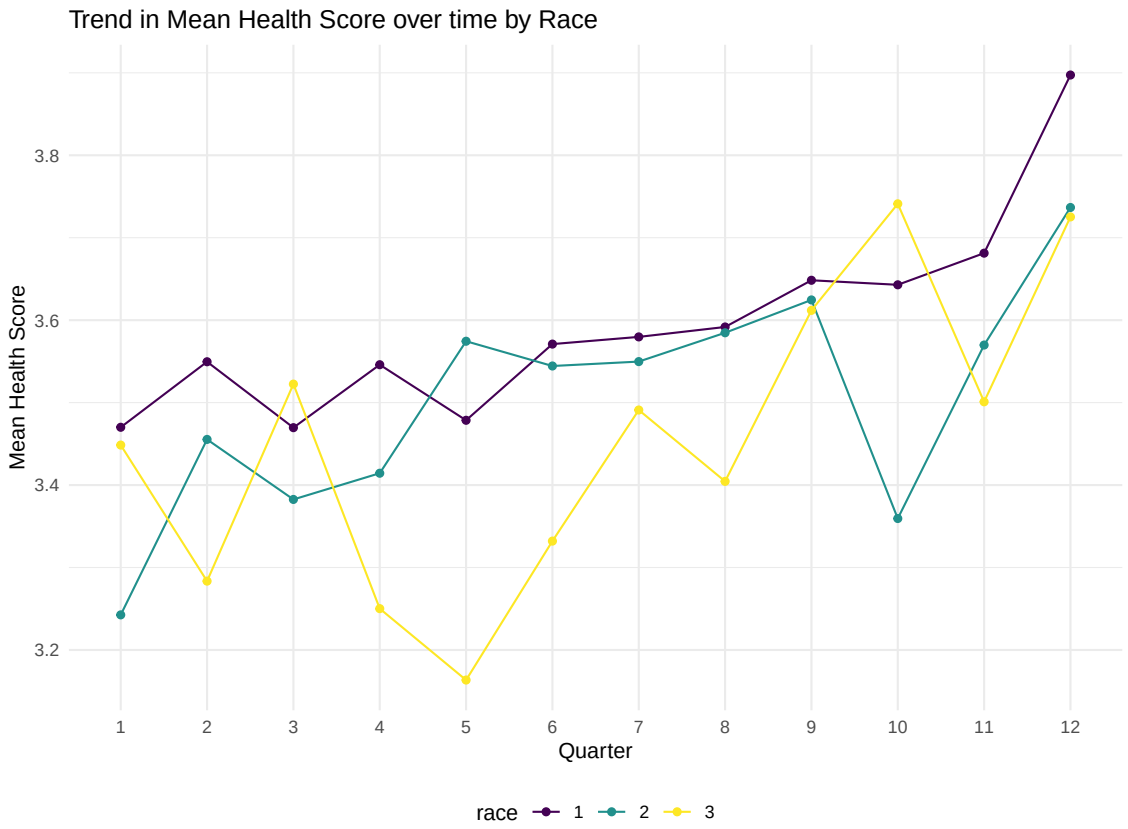


#Mean health score over time by race

```
health_race = practice_data %>%
  mutate(
    race = factor(race),
quarter = factor(quarter))
```

```
health_race = health_race %>%
  drop_na() %>%
  select(
    health_score, quarter, race
  ) %>%
  group_by(
    quarter, race
  ) %>%
  summarise(
    avg_score = mean(health_score)
  )
```

```
pe <- ggplot(health_race, aes(x = quarter, y = avg_score, group = race)) +
  geom_line(aes(color = race)) +
  geom_point(aes(color = race)) + labs(x = "Quarter", y = "Mean Health Score", title = "Trend in Mean H
pe
```



#Correcting the data quality issues

```
new_data = practice_data %>%
  drop_na() %>%
  filter(
    health_score <= 6,
    age >= 14, age <= 75
  )
```

#Checking the trend in mean health score over time in the corrected data

```
new_data %>%
  select(
    health_score, quarter
  ) %>%
  group_by(
    quarter
  ) %>%
  summarise(
    avg_score = mean(health_score)
  ) %>%
  knitr::kable()
```

quarter	avg_score
1	2.957220
2	3.062881

quarter	avg_score
3	3.053617
4	3.082009
5	3.080370
6	3.121949
7	3.192630
8	3.135304
9	3.177808
10	3.147629
11	3.234287
12	3.298995

#Mean health score over time by age group

```
new_data %>%
  select(
    health_score, quarter, age_cat
  ) %>%
  group_by(
    quarter, age_cat
  ) %>%
  summarise(
    avg_score = mean(health_score)
  ) %>%
knitr::kable()
```

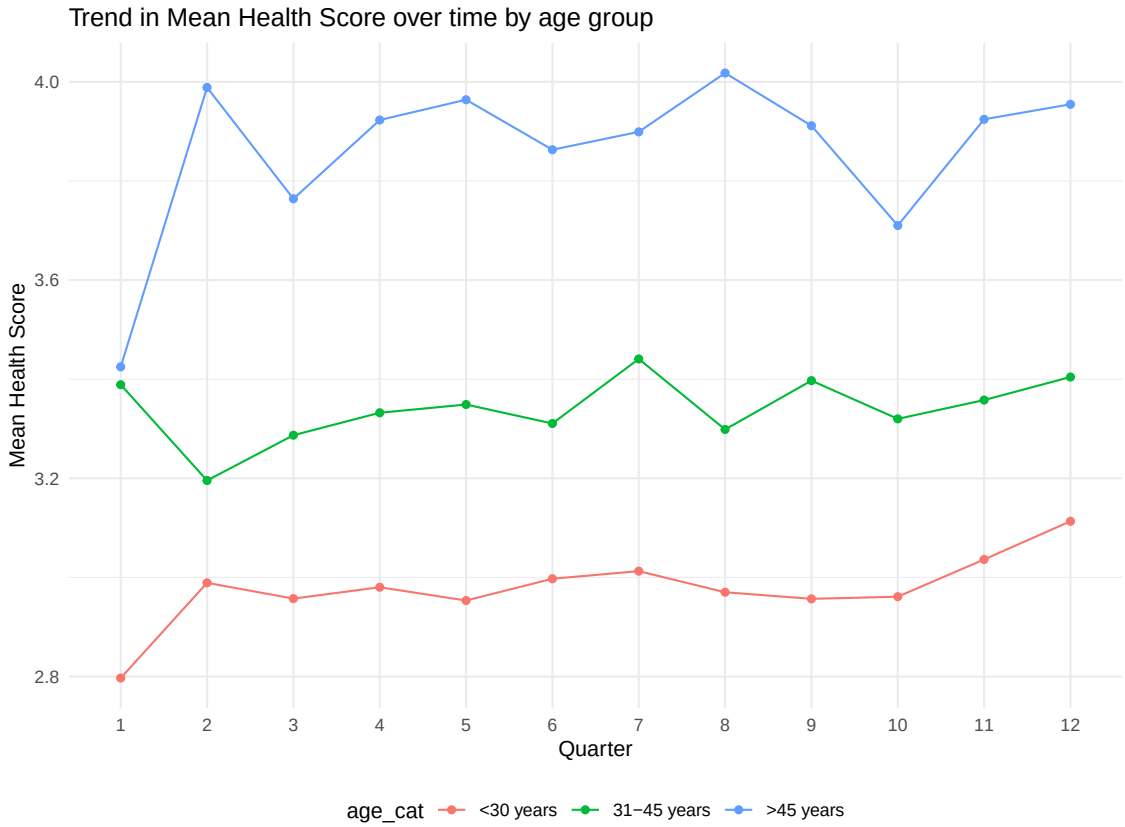
quarter	age_cat	avg_score
1	1	2.796936
1	2	3.388951
1	3	3.425028
2	1	2.989041
2	2	3.195572
2	3	3.988790
3	1	2.957211
3	2	3.287013
3	3	3.764033
4	1	2.980156
4	2	3.332257
4	3	3.922990
5	1	2.953362
5	2	3.348889
5	3	3.963946
6	1	2.997311
6	2	3.310626
6	3	3.863035
7	1	3.012671
7	2	3.440885
7	3	3.899116
8	1	2.970070
8	2	3.298552
8	3	4.017854

quarter	age_cat	avg_score
9	1	2.956768
9	2	3.397101
9	3	3.911494
10	1	2.961097
10	2	3.319968
10	3	3.710119
11	1	3.036243
11	2	3.357914
11	3	3.924474
12	1	3.113301
12	2	3.404411
12	3	3.954721

```
health_score = new_data %>%
  mutate(
    age_cat = factor(age_cat),
quarter = factor(quarter))
```

```
health_score = health_score %>%
  select(
    health_score, quarter, age_cat
  ) %>%
  group_by(
    quarter, age_cat
  ) %>%
  summarise(
    avg_score = mean(health_score)
  )
```

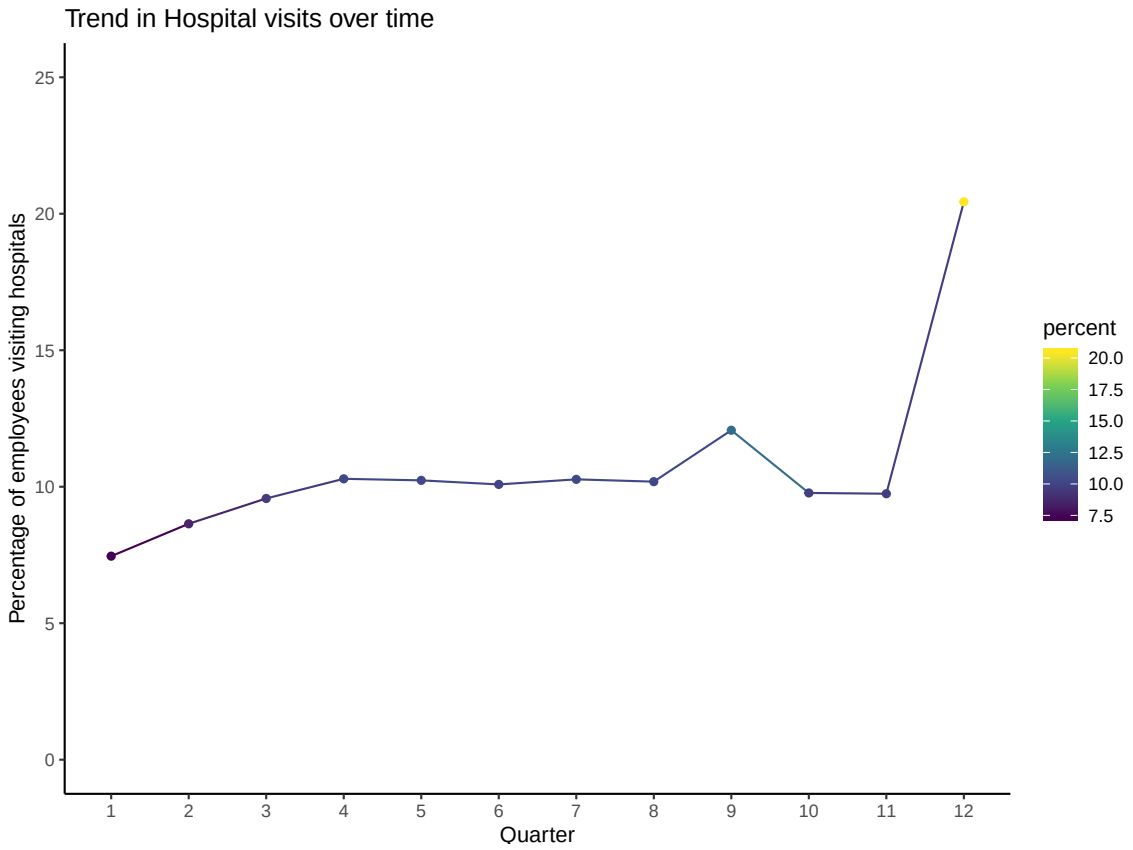
```
pn <- ggplot(health_score, aes(x = quarter, y = avg_score, group = age_cat)) +
  geom_line(aes(color = age_cat)) +
  geom_point(aes(color = age_cat)) + labs(x = "Quarter", y = "Mean Health Score", title = "Trend in Mea
pn
```



#Calculating the trend in hospital visits over time

```
hosp = practice_data %>%
  select(
    employee_id, hospital_visit, quarter
  ) %>%
  group_by(
    quarter
  ) %>%
  summarise(
    percent = (sum(hospital_visit)/n())*100
  )
```

```
s <- ggplot(hosp, aes(x = quarter, y = percent, color = percent)) + theme_classic() + geom_line() + geo
   scale_x_discrete(name = "Quarter", limits = c("1","2","3","4","5","6","7","8","9","10","11","12")) +
  scale_y_continuous(name = "Percentage of employees visiting hospitals",
                           breaks = seq(0, 25, 5),
                           limits = c(0, 25)) + labs(x = "Quarter", y = "Percentage of employees visiti
s
```



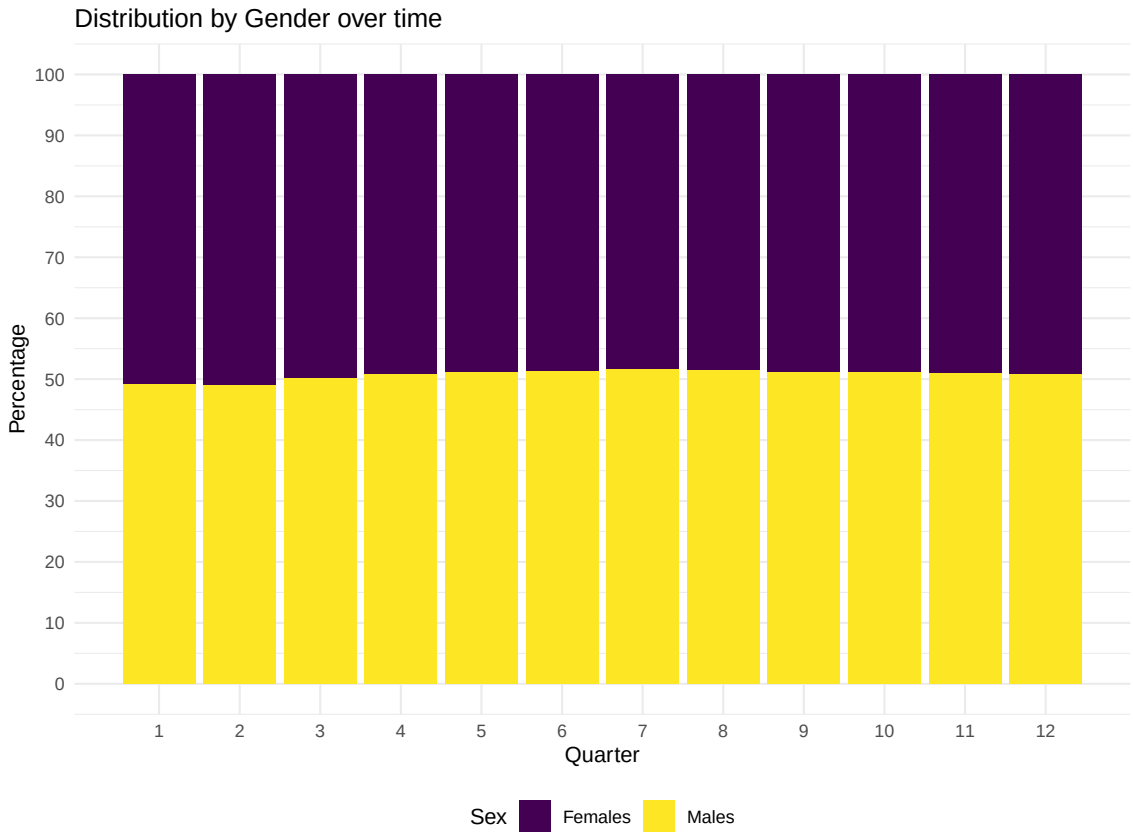
#Calculating the distribution by gender over time

```
w = practice_data %>%
  drop_na() %>%
  mutate(
    sex = factor(sex)
  ) %>%
  select(
     employee_id, quarter, sex
  ) %>%
  group_by(
    quarter, sex
  ) %>%
summarise(n = n()) %>%
mutate(freq = n / sum(n)*100)
w
```

```
## # A tibble: 24 x 4
## # Groups:   quarter [12]
##    quarter sex       n  freq
##      <dbl> <fct> <int> <dbl>
##  1       1 0       305  50.8
##  2       1 1       295  49.2
##  3       2 0       399  50.9
##  4       2 1       385  49.1
##  5       3 0       503  49.8
##  6       3 1       507  50.2
```

```
##  7       4 0       632  49.1
##  8       4 1       655  50.9
##  9       5 0       726  48.9
## 10       5 1       759  51.1
## # ... with 14 more rows
```

```
t = w %>%
  ggplot(aes(x = quarter, y = freq, fill = sex)) + geom_bar(stat = "identity", legend = c("Female", "Ma
  scale_y_continuous(name = "Percentage",
                           breaks = seq(0, 100, 10),
                           limits = c(0, 100)) + labs(x = "Quarter", y = "Percentage" , title = "Distri
t
```



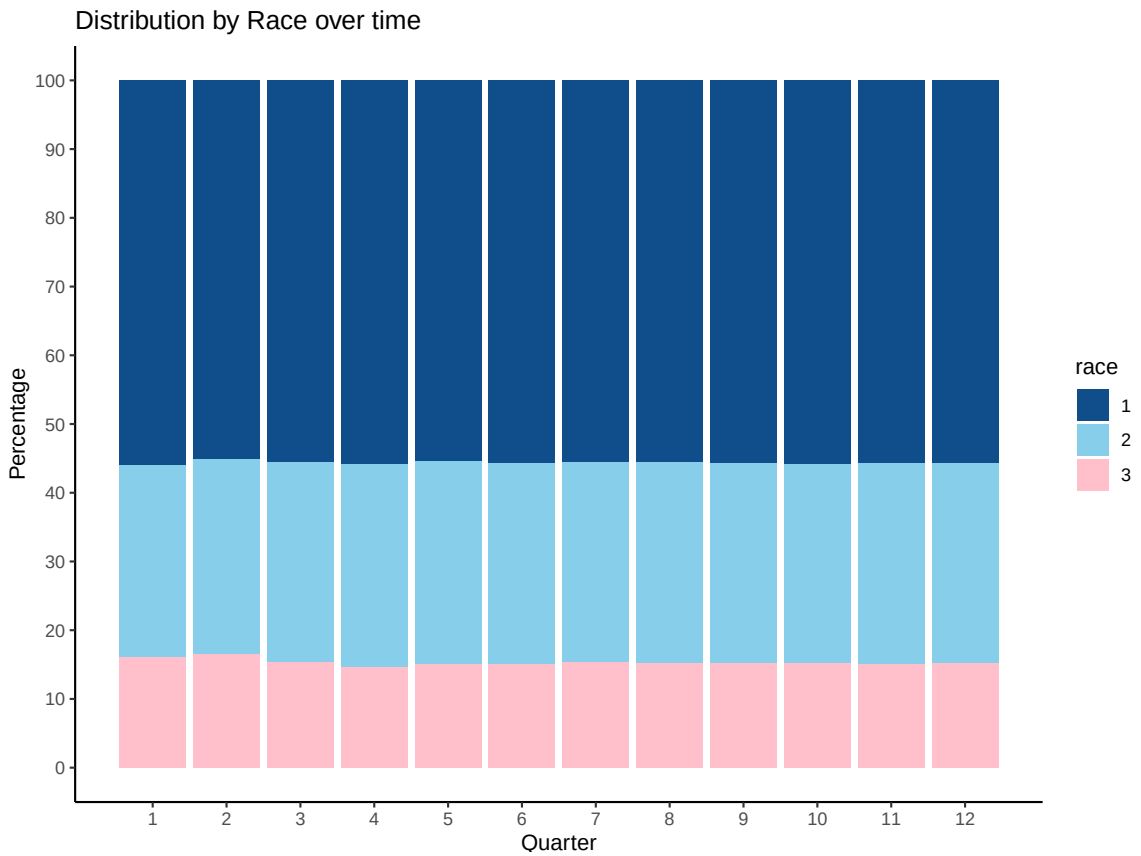
#Calculating the distribution by race over time

```
j = practice_data %>%
  drop_na() %>%
  mutate(
    race = factor(race)
  ) %>%
  select(
     quarter, race
  ) %>%
  group_by(
    quarter, race
  ) %>%
  summarise(n = n()) %>%
```

```
mutate(freq = n / sum(n)*100)
j
```

```
## # A tibble: 36 x 4
## # Groups:   quarter [12]
##    quarter race      n  freq
##      <dbl> <fct> <int> <dbl>
##  1       1 1       336  56.
##  2       1 2       167  27.8
##  3       1 3        97  16.2
##  4       2 1       432  55.1
##  5       2 2       222  28.3
##  6       2 3       130  16.6
##  7       3 1       561  55.5
##  8       3 2       293  29.0
##  9       3 3       156  15.4
## 10       4 1       718  55.8
## # ... with 26 more rows
```

```
k = j %>%
  ggplot(aes(x = quarter, y = freq, fill = race)) + geom_bar(stat = "identity") +
  theme_classic() + scale_fill_manual(values = c("dodgerblue4","skyblue","pink")) + scale_x_discrete(nam
  scale_y_continuous(name = "Percentage",
                           breaks = seq(0, 100, 10),
                           limits = c(0, 100)) + labs(x = "Quarter", y = "Percentage" , title = "Distril
k
```

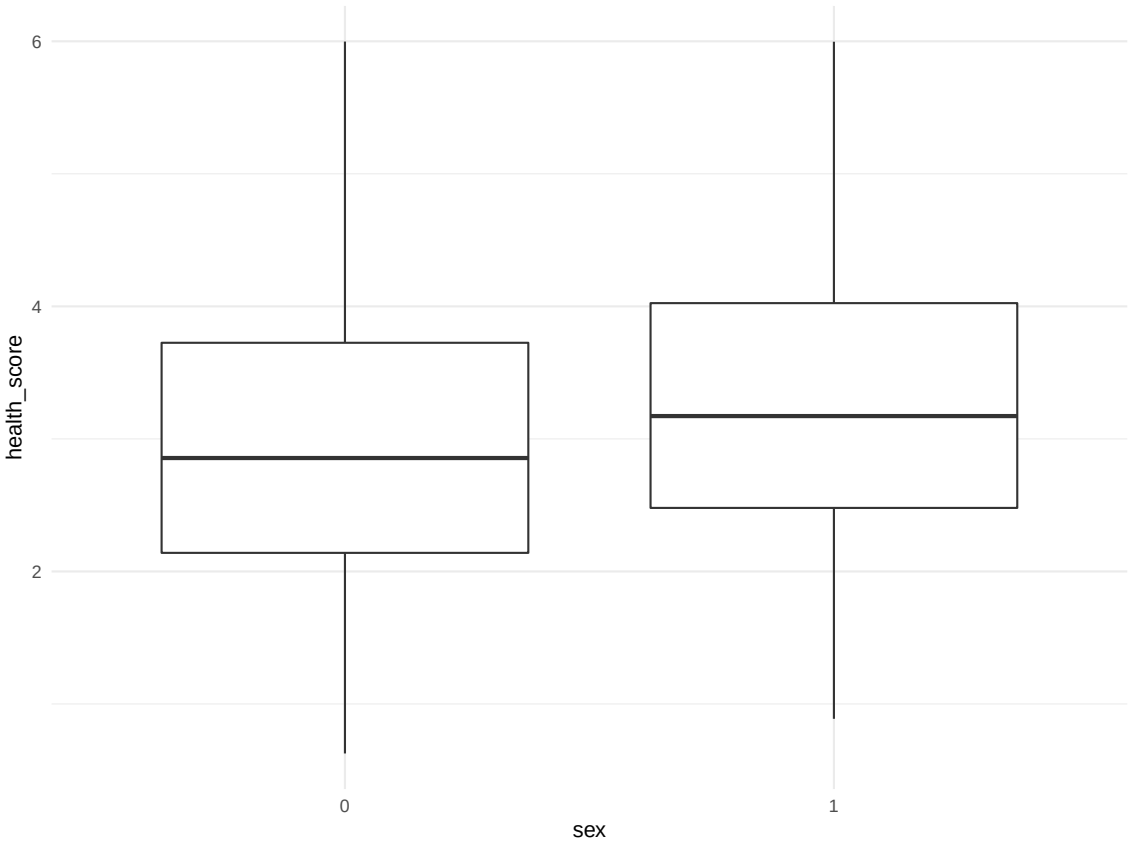


#Scatterplot between salary and health score

```
practice_data %>%
  filter(
    health_score <= 6
  ) %>%
  ggplot(
    aes(x = health_score, y = salary)
  ) + geom_point(aes(color = "yellow")) + labs(
    x = "Heath Score", y = "Salary", title = "Association between Salary and Health Score"
  ) + scale_x_discrete(name = "Quarter", limits = c("1","2","3","4","5","6","7","8","9","10","11","12"))
```

#Box-plot showing the Mean health score for both genders

```
practice_data %>%
  drop_na() %>%
  filter(
    health_score <= 6
  ) %>%
  mutate(
    sex = factor(sex)
  ) %>%
  ggplot(
    aes(
      x = sex, y = health_score
    )
  ) + geom_boxplot()
```



#Checking the association between sex and health score using two sample t-test

```
t.test(health_score ~ sex, data = new_data)
```

```
##
##  Welch Two Sample t-test
##
## data:  health_score by sex
## t = -17.726, df = 15816, p-value < 2.2e-16
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -0.3343974 -0.2678069
## sample estimates:
## mean in group 0 mean in group 1
##        2.995977        3.297079
```

#Checking the association between hospital visit and health score using two sample t-test

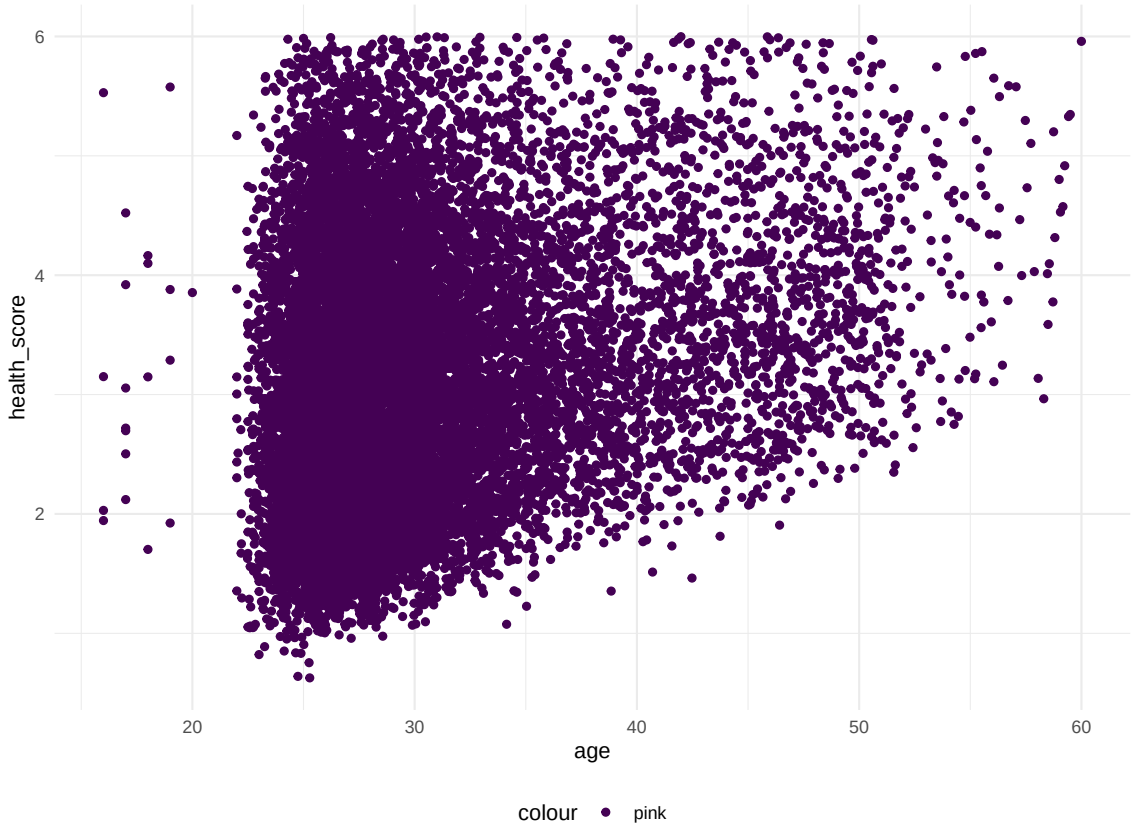
```
t.test(health_score ~ hospital_visit, data = new_data)
```

```
##
##  Welch Two Sample t-test
##
## data:  health_score by hospital_visit
## t = -26.924, df = 2278.4, p-value < 2.2e-16
## alternative hypothesis: true difference in means is not equal to 0
```

```
## 95 percent confidence interval:
##  -0.7129211 -0.6161208
## sample estimates:
## mean in group 0 mean in group 1
##        3.076413        3.740934
```

#Scatterplot showing the association between age and health score

```
new_data %>%
  filter(
    age <= 60
  ) %>%
ggplot(
  aes(
    x = age, y = health_score
  )
) + geom_point(
  aes(color = "pink")
)
```



#Checking the association between race and health score

```
av <- aov(health_score ~ race, data = new_data)
summary(av)
```

```
##                Df Sum Sq Mean Sq F value  Pr(>F)
## race            1     12  11.726   10.06 0.00152 **
```

```
## Residuals   15876  18513   1.166
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

#Creating 2*2 tables

```
practice_data %>%
 filter(
   age_cat != 3
 ) %>%
 mutate(
   sal_cat = case_when(
     salary < 40000 ~ "First",
     salary > 40000 ~ "Second"
   )
 ) %>%
 janitor::tabyl(age_cat, sal_cat)
```

```
##  age_cat First Second
##        1   678  11192
##        2   337   5884
```

```
practice_data %>%
 filter(
   age_cat != 3
 ) %>%
 mutate(
   sal_cat = case_when(
     salary < 40000 ~ "First",
     salary > 40000 ~ "Second"
   )
 ) %>%
 group_by(age_cat,sal_cat) %>%
 summarise(
   n = n()
 ) %>%
 pivot_wider(
   names_from = sal_cat, values_from = n
 )
```

```
## # A tibble: 2 x 3
## # Groups:   age_cat [2]
##   age_cat First Second
##     <dbl> <int>  <int>
## 1       1   678  11192
## 2       2   337   5884
```

#General summaries

```
practice_data %>%
 group_by(
   quarter
```

```
  ) %>%
  summarise(
    n = n(),
    mean_age = mean(age),
    median_age = median(age),
    mean_salary = mean(salary),
    median_salary = median(salary)
    )
```

```
## # A tibble: 12 x 6
##    quarter     n mean_age median_age mean_salary median_salary
##      <dbl> <int>    <dbl>      <dbl>       <dbl>         <dbl>
##  1       1   684     28.8       26.6      43628.        43612.
##  2       2   891     28.6       26.5      44274.        44254.
##  3       3  1139     28.6       26.8      45021.        45002.
##  4       4  1448     28.8       27.1      45531.        45464.
##  5       5  1671     29.3       27.6      46133.        46119.
##  6       6  1775     29.9       28.1      46948.        46915.
##  7       7  1850     30.5       28.5      47780.        47749.
##  8       8  1885     30.9       28.9      48667.        48664.
##  9       9  1914     31.4       29.3      49562.        49603.
## 10      10  1934     31.8       29.6      50498.        50548.
## 11      11  1950     32.2       29.9      51433.        51512.
## 12      12  1962     32.6       30.2      52376.        52440.
```