Analysis on key factors affecting life satisfaction

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Abstract

Here is where you give a brief (one paragraph overview of your entire paper). This should include some background/introduction, some methodology, results and conclusions.

We use the 2017 General Social Survey(GSS) data to study the response of people in Canada's life satisfactions to _____. The target population includes all non-institutionalized persons 15 years of age and older, living in the 10 provinces of Canada. The frame population is everyone who is registered combining both landline and cellular with Statistics Canada's address registers, and the sampled population is whoever is reached via telephone. The target population was stratified into 27 strata by geographic areas – mostly CMA – and simple random sampling without replacement of records was performed in each stratum.
Through the analysis, We find....
1. a strong ....
2. no overall effects in ....

Together, these results suggest that.....

Introduction

Here is where you should give insight into the setting and introduce the goal of the analysis. Here you can introduce ideas and basic concepts regarding the study setting and the potential model. Again, this is the introduction, so you should be explaining the importance of the work that is ahead and hopefully build some suspense for the reader. You can also highlight what will be included in the subsequent sections.

**INTRO (1) In recent periods, COVID-19 crisis has changed many things. Millions of people have lost their jobs, untold numbers of people fear they could lose their incomes any day, and people are having constant worries for their relates health and their own.

There are many factors that determines people's satisfaction and well being of their life. It could be people's health, income, family, religion, or other elements that makes them feel satisfied. Specially, in situation where we are living in full of uncertainty, people are feeling more stressed and those concerns give negative influence on their own's well being. Under the circumstances we wanted to take a close look on which factors of people's life has the most impact on people's satisfaction of their lives.

The data set we chose for this assignment contains responses of the General Social Survey conducted in 2017. The 2017 GSS data are monitoring changes in the living conditions and well being of Canadians over time. The 2017 GSS data includes variety of different variables such as, age, sex, education, feelings life, self rated health, income, etc. With the collected data we can analyze how people's satisfaction score is dependent and has significant relationship with different factor variables.

The following sections will use statistical methods to build new models and analyze the data. It includes cleaning the data into simpler model, linear regression modeling to find the significance of satisfaction score and predictor variables, comparing and creating graphical visualizations.

Data

Introduce the data, explain why it was selected. Make sure to comment on important features and highlight any potential drawbacks to the data.

** Guemin
The data set we chose for this assignment contains responses of the General Social Survey conducted in 2017. The contents of the survey include some characteristics of diverse families in Canada, their socio-economic status, as well as other subjective information such as the respondent's life satisfaction and health conditions.

Since we want to identify some key factors affecting one's life satisfaction as mentioned previously, the focus of our analysis will be "Health and subjective well-being".

The reason for choosing the 2017 GSS is because it is the most recent[1] survey that includes the "Health and subjective well being" concept.

Since the original data set contains too many variables that are not neccessary, we are going to clean the data set prior to analysis by removing them.

This is what our new data looks like:

```
## # A tibble: 6 x 8
##      ID   age sex   satisfaction_sc~ self_rated_heal~ self_rated_ment~
##   <dbl> <dbl> <chr>            <dbl>            <dbl>            <dbl>
## 1     1  52.7 Fema~                8                5                5
## 2     2  51.1 Male                10                3                3
## 3     5  28   Male                 8                3                3
## 4     9  63.8 Fema~                8                4                4
## 5    11  15.7 Male                10                5                5
## 6    12  40.3 Fema~                6                4                3
## # ... with 2 more variables: family_income <chr>, work_hours <chr>
```

Our data contains 8 variables: ID, age, sex, satisfaction_score, self_rated_health, self_rated_mental_health, family_income, and work_hours.

Detailed descriptions of some variables:
* satisfaction_score indicates the life satisfaction score on a scale of 0(very dissatisfied) to 10(very satisfied).
* self_rated_health and self_rated_mental health are the physical and mental health ratings, respectively, on a scale of 1(poor) to 5(Excellent) given by the respondent.
* work_hours indicates the average number of hours worked per week.

Since we want to observe how the life satisfaction score is related to potential factors such as health or financial conditions, the response variable of our analysis will be satisfaction_score and the predictors will be the potential factors: self_rated_health, self_rated_mental_health, family_income, and work_hours. **

Model

Introduce the selected model here. It is expected that you will use some mathematical notation here. If you do please ensure that all notation is explained. You may also want to discuss any special (hypothetical) cases of your model here, as well as any caveats.

**

[1] As it is stated in the documentation of the GSS, one of the primary objectives of the General Social Survey is to monitor the well being of Canadians over time. As a result, every survey conducted so far contain the responses related to the questions asking for the respondents' well being, and the 2017 GSS is the most recent survey with such reponses.

Now, we are going to fit a multiple linear regression model in order to find linear associations between satisfaction_score and other predictor variables: self_rated_health, self_rated_mental_health, family_income, and work_hours.

Here is the summary of the multiple linear regression model:

```
##
## Call:
## lm(formula = satisfaction_score ~ as.factor(self_rated_health) +
##     as.factor(self_rated_mental_health) + family_income + work_hours,
##     data = life_satisfaction_data)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -9.1029 -0.7224  0.0663  0.8971  6.1204
##
## Coefficients:
##                                     Estimate Std. Error t value Pr(>|t|)
## (Intercept)                          3.92502    0.29485  13.312  < 2e-16 ***
## as.factor(self_rated_health)2        0.51471    0.10379   4.959 7.17e-07 ***
## as.factor(self_rated_health)3        0.83475    0.09740   8.571  < 2e-16 ***
## as.factor(self_rated_health)4        0.98584    0.09793  10.067  < 2e-16 ***
## as.factor(self_rated_health)5        1.17522    0.09973  11.784  < 2e-16 ***
## as.factor(self_rated_mental_health)2  1.63274    0.11629  14.040  < 2e-16 ***
## as.factor(self_rated_mental_health)3  2.69951    0.10889  24.790  < 2e-16 ***
## as.factor(self_rated_mental_health)4  3.24499    0.10932  29.684  < 2e-16 ***
## as.factor(self_rated_mental_health)5  3.72145    0.11004  33.818  < 2e-16 ***
## family_income$125,000 and more        0.04865    0.03822   1.273 0.203047
## family_income$25,000 to $49,999      -0.36600    0.04275  -8.561  < 2e-16 ***
## family_income$50,000 to $74,999      -0.14543    0.04231  -3.437 0.000589 ***
## family_income$75,000 to $99,999      -0.12047    0.04285  -2.811 0.004939 **
## family_incomeLess than $25,000       -0.47951    0.05232  -9.166  < 2e-16 ***
## work_hours0.1 to 29.9 hours           0.29608    0.27262   1.086 0.277474
## work_hours30.0 to 40.0 hours          0.23252    0.27176   0.856 0.392231
## work_hours40.1 to 50.0 hours          0.32056    0.27335   1.173 0.240935
## work_hours50.1 hours and more         0.39476    0.27448   1.438 0.150400
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.298 on 12927 degrees of freedom
##   (62 observations deleted due to missingness)
## Multiple R-squared:  0.2733, Adjusted R-squared:  0.2724
## F-statistic:   286 on 17 and 12927 DF,  p-value: < 2.2e-16
```

With the estimates frome the regression output, we know that our regression model has a form:

$$Satisfaction\ Score = 3.92502 + 0.51471 * x_{health2} + 0.83475 * x_{health3} + 0.98584 * x_{health4} + 1.17522 * x_{health5} + 1.63274 * x_{mental2} + 2.69951 * x_{mental3} + 3.24499 * x_{mental4} + 3.72145 * x_{mental5} - 0.47951 * x_{income1} - 0.36600 * x_{income2} - 0.14543 * x_{income3} - 0.12047 * x_{income4} + 0.04865 x_{income5} + 0.29608 * x_{work1} + 0.23252 * x_{work2} + 0.32056 * work3 + 0.39476 * x_{work4}$$

where x_{health} is a physical health rating indicator (i.e. $x_{health5} = 1$ if the respondent's self_rated_health = 5, and $x_{health5} = 0$ otherwise), x_{mental} is a mental health rating indicator, x_{income} is an average income range indicator, and x_{work} is a working hours indicator.

As we can observe from the output, estimated satisfaction_score increases as each of self_rated_health and self_rated_mental_health and family_income increases; however, the slope estimates for work_hours are

found to be quite inconsistent, because there is a decrease in slope estimates from 0.29608 to 0.23252 in the first two intervals of work_hours, but it increases again in the third and fourth intervals.
Furthermore, p-values for average_hours_worked that are much greater than the significance level of 0.05 provide us with more evidence that there is no linear relationship between the average working hours and the life satisfaction score.

On the other hand, the p-values for the family_income estimates are less than the significance level in most cases, but for those with income greater than or equal to $125,000, corresponding p-value is greater than 0.05. Therefore, we need more investigation on whether the change in family_income actually contributes in changing the value of satisfaction_score.

Hence, for now, the regression model suggests that only the physical and mental health condition have positive linear relationships with the life satisfaction score.

Now that we've found out that the life satisfaction score has linear relationships with health conditions, we want to ask ourselves: are those factors(physical and mental health conditions) equally important in terms of explaning the variability in satisfaction_score?

The answer is 'No'.

Although they all have positive linear relationships with the response variable, not all variables may contribute significantly in explaining the variability of the response variable.

Hence, we would now like to identify the most important predictor variable in this regression model. Also, we will investigate if the family income contributes significantly in explaining the variability of life satisfaction score.

There are two ways to do this[2].

In this analysis, we are going to use the method where we compute and compare the changes in $R^2_{adjusted}$ for the last variable added to the model[3]. This is a valid method for identifying which predictor explains the most variability in the response variable, because when a newly added predictor variable is the only difference between the two models, the associated change in 'R^2 Adjusted' will represent the 'goodness-of-fit'.

*Note, we are using 'R^2 Adjusted' instead of R^2, because even if the newly added predictor is not significant, R^2 can be inflated by adding more predictors to the model.

To be more specific, we are going to begin with fitting a linear model with only one predictor, and then add one predictor to the model at a time to see how much $R^2_{adjusted}$ changes when each variable is added.

Key point in this method is to identify the predictor variable with the largest increase in $R^2_{adjusted}$ when it is the last variable added to the model.

This is the table with R^2 values in each model, and the change in R^2 as more variables are added:

```
## # A tibble: 3 x 2
##   R_squared Change
##       <dbl>  <dbl>
## 1     0.117 0.117
## 2     0.240 0.122
## 3     0.253 0.0137
```

As it is shown in the table, there is a greatest increase in $R^2_{adjusted}$ when the second predictor, self_rated_mental_health is added to the model. This increase is quite close the $R^2_{adjusted}$ of our initial simple linear regression model with predictor self_rated_health.

[2]One way is to compare the standardized regression coefficients, and the other way is to compare the increases in adjusted R-squared when each predictor is added to the regression model. For this analysis, specifically, we cannot not use the first method, because our model contains categorical predictor variable which cannot be standardized.

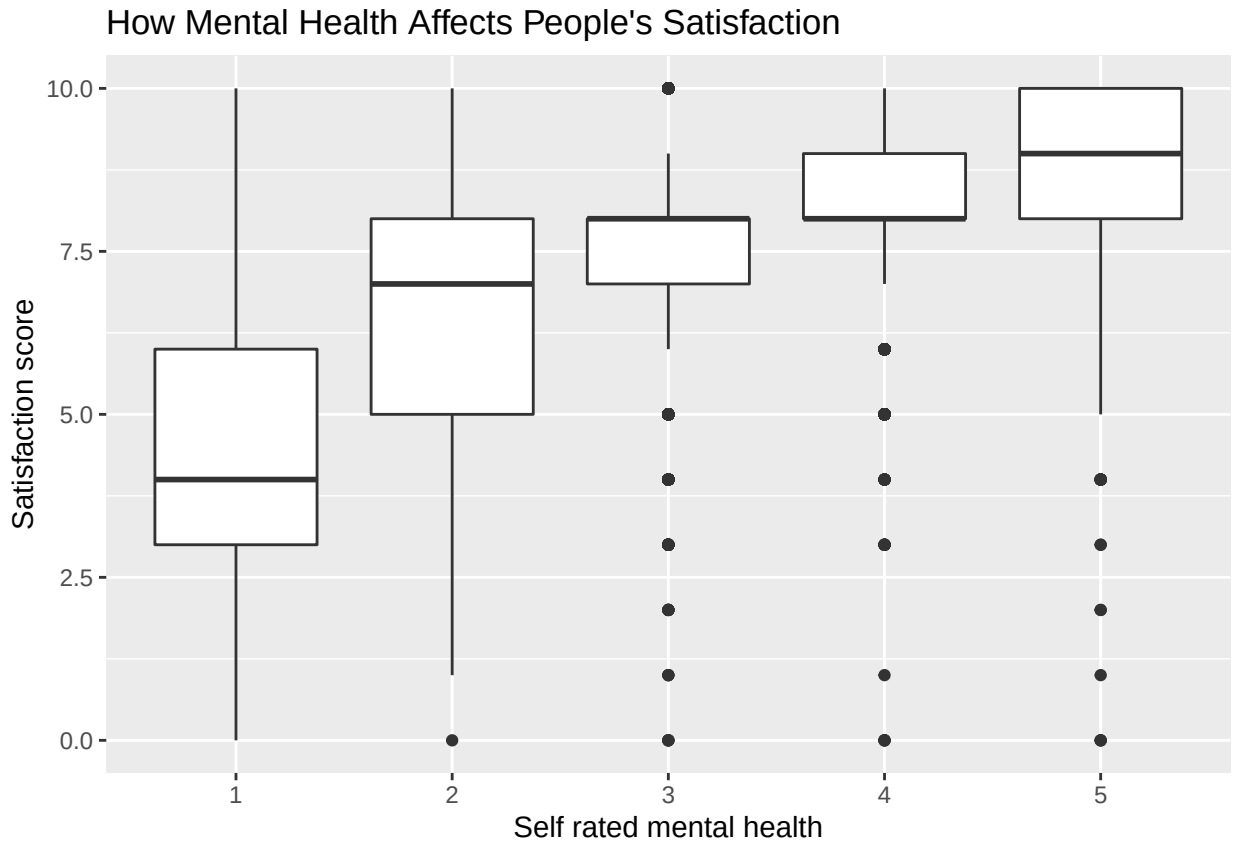
[3]$R^2_{adjusted} = 1 - (1 - R^2) * (\frac{n-1}{n-p-1})$ where n is the total sample size and p is the number of additional predictor variables. Hence, unlike R^2, if the newly added predictor does not explain variation in the response variable well, $R^2_{adjusted}$ will go down.

On the other hand, since the change in $R^2_{adjusted}$ is relatively small when family_income is added to the regression model compared to the previous changes, we know that the family income does not contribute significantly in explaning the variation in the satisfaction score.

Hence, the result suggests that physical and mental health are significant predictors, however, mental health is a more important factor than physical health in terms of explaining the variability of the life satisfaction score.

```
life_satisfaction_data %>%
  ggplot(aes(x = as.factor(self_rated_mental_health), y = (satisfaction_score))) + geom_boxplot() +
  ggtitle("How Mental Health Affects People's Satisfaction") +
  ylab("Satisfaction score") +
  xlab("Self rated mental health")
```

```
## Warning: Removed 62 rows containing non-finite values (stat_boxplot).
```



Results

Here you will include all results. This includes descriptive statistics, graphs, figures, tables, and model results. Please ensure that everything is well formatted and in a report style. You must also provide an explanation of the results in this section. You can overflow to an Appendix if needed.

Please ensure that everything is well labelled. So if you have multiple histograms and plots, calling them Figure 1, 2, 3, etc. and referencing them as Figure 1, Figure 2, etc. in your report will be expected. The reader should not get lost in a sea of information. Make sure to have the results be clean, well formatted and digestible.

Discussion

Here you will discuss conclusions drawn from the results and comment on how it relates to the original goal of the study (which was specified in the Introduction).

Weaknesses

Here we discuss weaknesses of the study, data, analysis, etc. You can also discuss areas for improvement.

Next Steps

Here you discuss subsequent work to be done after this report. This can include next steps in terms of statistical analysis (perhaps there is a more efficient algorithm available, or perhaps there is a caveat in the data that would allow for some new technique). Future steps should also be specified in terms of the study setting (eg. including a follow-up survey on something, or a subsequent study that would complement the conclusions of your report).

References

1. GSS Data:
2. Data Cleaning Code: