Project Proposal

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Load Packages

```
install.packages("taRifx")
install.packages("fastDummies")
library(tidyverse)
library(dplyr)
library(taRifx)
library(fastDummies)
```

Load Data

```
drug <- readr::read_csv("Drug_Consumption.csv")
```

Introduction and Data, including Research Questions

The goal of this research is to determine whether or not lower personality scores correlate with more frequent abuse of illegal drugs. Further, how do these trends differ across gender and age lines? A study conducted by Turiano, Nicholas A et al., "Personality and Substance Use in Midlife: Conscientiousness as a Moderator and the Effects of Trait Change," highlights the cruciality of examining the links between personality and substance abuse, for the former is a prime predictor of the latter across stages of life (Turiano et al., 2012). This dataset amasses figures pertaining to the drug consumption and personality scores of 1885 participants hailing from predominantly white, English speaking countries. The data include observations on both legal and illegal drugs: alcohol, amphetamines, amyl nitrite, benzodiazepine, cannabis, chocolate, cocaine, caffeine, crack, ecstasy, heroin, ketamine, legal highs, LSD, methadone, mushrooms, nicotine, and a class of volatile substance abuse. The various personality traits, neuroticism, extraversion, openness to experience, agreeableness, and conscientiousness, were quantified using the NEO-FFI-R measurement, and impulsivity and sensation seeking attributes were measured using BIS-11 and ImpSS, respectively. The dataset also contains the binary gender identity, age category, ethnicity, country of residence, and educational background of all of the participants. For the purposes of this research project, ethnicity, country of residence, and educational background are likely to be unimportant or unhelpful given that the vast majority are white and the data on education are not readily quantifiable. Further, the primary focus will be on the use, or lack thereof, of illegal drugs and will not qualify the legal drugs as "drug usage."

Glimpse

```
glimpse(drug, width = getOption("width"))
```

```
## Rows: 1,884
## Columns: 32
## $ ID        <dbl> 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, ~
## $ Age       <chr> "25-34", "35-44", "18-24", "35-44", "65+", "45-54", "35-44",~
## $ Gender    <chr> "M", "M", "F", "F", "F", "M", "M", "F", "M", "F", "M", "F", ~
## $ Education <chr> "Doctorate degree", "Professional certificate/ diploma", "Ma~
## $ Country   <chr> "UK", "UK", "UK", "UK", "Canada", "USA", "UK", "Canada", "UK~
## $ Ethnicity <chr> "White", "White", "White", "White", "White", "White", "White~
## $ Nscore    <dbl> -0.67825, -0.46725, -0.14882, 0.73545, -0.67825, -0.46725, -~
## $ Escore    <dbl> 1.93886, 0.80523, -0.80615, -1.63340, -0.30033, -1.09207, 1.~
## $ Oscore    <dbl> 1.43533, -0.84732, -0.01928, -0.45174, -1.55521, -0.45174, -~
## $ AScore    <dbl> 0.76096, -1.62090, 0.59042, -0.30172, 2.03972, -0.30172, -0.~
## $ Cscore    <dbl> -0.14277, -1.01450, 0.58489, 1.30612, 1.63088, 0.93949, 1.63~
## $ Impulsive <dbl> -0.71126, -1.37983, -1.37983, -0.21712, -1.37983, -0.21712, ~
## $ SS        <dbl> -0.21575, 0.40148, -1.18084, -0.21575, -1.54858, 0.07987, -0~
## $ Alcohol   <chr> "CL5", "CL6", "CL4", "CL4", "CL2", "CL6", "CL5", "CL4", "CL6~
## $ Amphet    <chr> "CL2", "CL0", "CL0", "CL1", "CL0", "CL0", "CL0", "CL0", "CL1~
## $ Amyl      <chr> "CL2", "CL0", "CL0", "CL1", "CL0", "CL0", "CL0", "CL0", "CL0~
## $ Benzos    <chr> "CL0", "CL0", "CL3", "CL0", "CL0", "CL0", "CL0", "CL0", "CL1~
## $ Caff      <chr> "CL6", "CL6", "CL5", "CL6", "CL6", "CL6", "CL6", "CL6", "CL6~
## $ Cannabis  <chr> "CL4", "CL3", "CL2", "CL3", "CL0", "CL1", "CL0", "CL0", "CL1~
## $ Choc      <chr> "CL6", "CL4", "CL4", "CL6", "CL4", "CL5", "CL4", "CL6", "CL6~
## $ Coke      <chr> "CL3", "CL0", "CL2", "CL0", "CL0", "CL0", "CL0", "CL0", "CL0~
## $ Crack     <chr> "CL0", "CL0", "CL0", "CL0", "CL0", "CL0", "CL0", "CL0", "CL0~
## $ Ecstasy   <chr> "CL4", "CL0", "CL0", "CL1", "CL0", "CL0", "CL0", "CL0", "CL0~
## $ Heroin    <chr> "CL0", "CL0", "CL0", "CL0", "CL0", "CL0", "CL0", "CL0", "CL0~
## $ Ketamine  <chr> "CL2", "CL0", "CL2", "CL0", "CL0", "CL0", "CL0", "CL0", "CL0~
## $ Legalh    <chr> "CL0", "CL0", "CL0", "CL1", "CL0", "CL0", "CL0", "CL0", "CL0~
## $ LSD       <chr> "CL2", "CL0", "CL0", "CL0", "CL0", "CL0", "CL0", "CL0", "CL0~
## $ Meth      <chr> "CL3", "CL0", "CL0", "CL0", "CL0", "CL0", "CL0", "CL0", "CL0~
## $ Mushrooms <chr> "CL0", "CL1", "CL0", "CL2", "CL0", "CL0", "CL0", "CL0", "CL0~
## $ Nicotine  <chr> "CL4", "CL0", "CL2", "CL2", "CL6", "CL6", "CL0", "CL6", "CL6~
## $ Semer     <chr> "CL0", "CL0", "CL0", "CL0", "CL0", "CL0", "CL0", "CL0", "CL0~
## $ VSA       <chr> "CL0", "CL0", "CL0", "CL0", "CL0", "CL0", "CL0", "CL0", "CL0~
```

Data Analysis Plan

In order to analyze these data, the drug usage of the various illegal drugs will be considered the outcome variable while the personality scores will be the explanatory variable. Both gender and age categories are additional data that constitute comparison groups to facilitate the answering of the overarching research question and provide compelling juxtapositions. To visualize these trends, a bar plot that has age on the x-axis, average drug use on the y-axis, is dodged by gender, and faceted by drug type would be helpful to see the relationship between all of these variables. Finally, an ANOVA model is a statistical method that will prove very helpful in answering the proposed research question. An ANOVA model can help determine if there is sufficient evidence that lower personality scores lead to more frequent illegal drug usage. "Drug usage" is quantified by the average use of each drug based on the rating. In other words, a drug with an average rating of 5 is considered more frequently used than a drug with an average rating of 2.

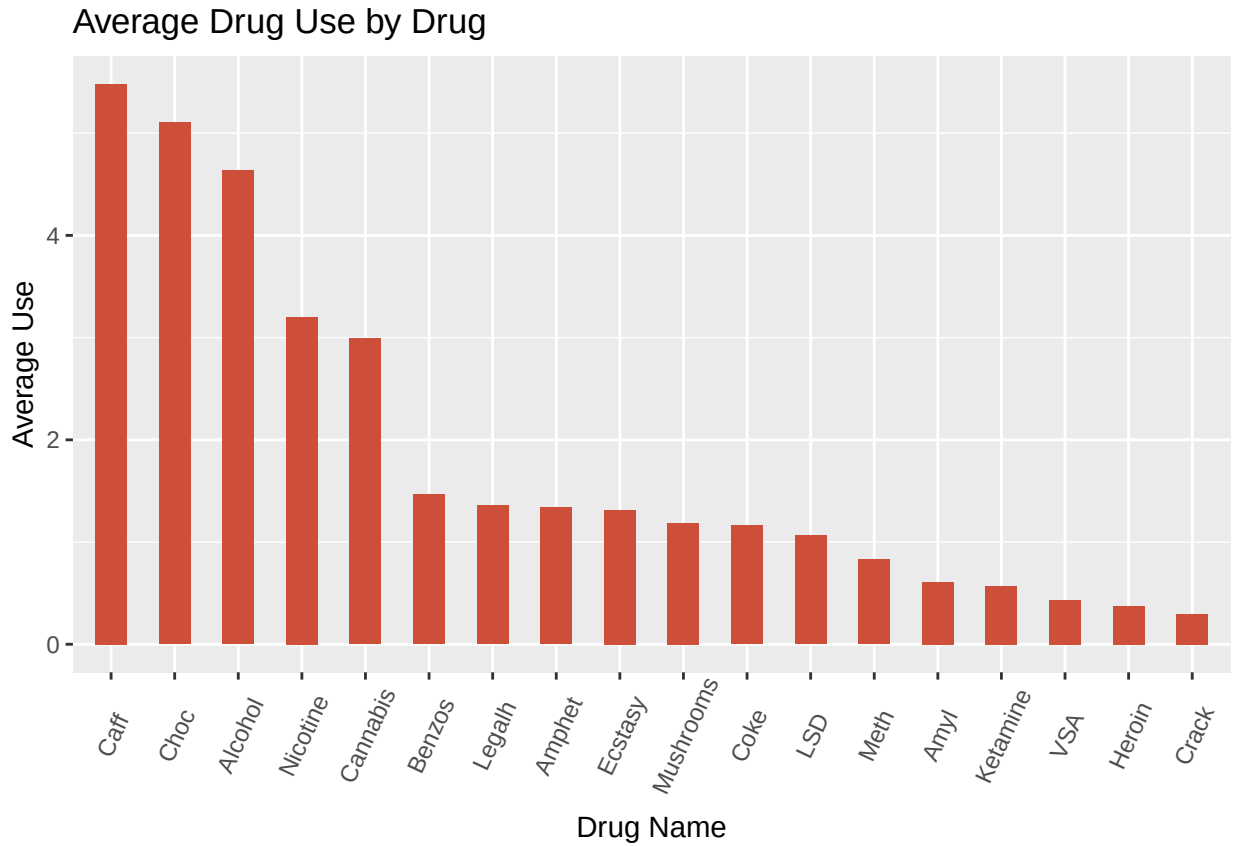
```
drug1 <- drug %>%
  mutate(across(Alcohol:VSA,destring))
```

```
drug1[,14:32] <- sapply(drug1[,14:32],as.numeric)
drugmeans <- colMeans(drug1[ , 14:32])
```

```r
drug_name <- c('Alcohol', 'Amphet', 'Amyl', 'Benzos', 'Caff', 'Cannabis', 'Choc', 'Coke', 'Crack', 'Ecs
average_use <- c(4.63481953, 1.34023355, 0.60721868, 1.46496815, 5.48354565, 2.99097665, 5.10668790, 1.
drug_averages <- data.frame(drug_name, average_use) %>%
print
```

```
##    drug_name average_use
## 1    Alcohol   4.6348195
## 2     Amphet   1.3402335
## 3       Amyl   0.6072187
## 4     Benzos   1.4649682
## 5       Caff   5.4835456
## 6   Cannabis   2.9909766
## 7       Choc   5.1066879
## 8       Coke   1.1618896
## 9      Crack   0.2977707
## 10   Ecstasy   1.3147558
## 11    Heroin   0.3742038
## 12  Ketamine   0.5695329
## 13    Legalh   1.3566879
## 14       LSD   1.0621019
## 15      Meth   0.8269639
## 16 Mushrooms   1.1878981
## 17  Nicotine   3.2011677
## 18       VSA   0.4336518
```

```r
drug_averages$drug_name <- factor(drug_averages$drug_name,
                  levels = drug_averages$drug_name[order(drug_averages$average_use, decreasing = TRUE)]]
ggplot(drug_averages, aes(x=drug_name, y=average_use)) +
  geom_bar(stat="identity", width=.5, fill="tomato3") +
  labs(title="Average Drug Use by Drug",
       x = "Drug Name",
       y = "Average Use") +
  theme(axis.text.x = element_text(angle=65, vjust=0.6))
```



Visualization Description: This plot shows the relationship between the drugs in our data set and their average use values. To make this plot we created a new dataframe in which the observations for the drug variables are numerical values corresponding to respondents' drug use history: 0 = never used the drug, 1 = used it over a decade ago, 2 = in the last decade, 3 = used in the last year, 4 = used in the last month, 5 = used in the last week, 6 = used in the last day. Then, we found the average values of each drug column and created a bar plot in descending order according to average drug use.

The most commonly used drugs are caffeine, chocolate, alcohol, nicotine, and cannabis. The least commonly used drugs are crack, heroine, VSA, ketamine, and amyl. Semer is not included in the bar plot because it is a fictitious drug only included in the survey to filter out over-claiming survey respondents.

```
num_drug <- drug1 %>%
  mutate(Age = replace(Age, Age == "18-24", 0), Age = replace(Age, Age == "25-34", 1), Age = replace(Ag

numdrug <- mutate_all(num_drug, function(x) as.numeric(as.character(x)))
```

```
head(numdrug)
```

```
## # A tibble: 6 x 32
##      ID   Age Gender Education Country Ethnicity Nscore Escore  Oscore AScore
##   <dbl> <dbl>  <dbl>     <dbl>   <dbl>     <dbl>  <dbl>  <dbl>   <dbl>  <dbl>
## 1     2     1      1         8       5         6 -0.678  1.94   1.44    0.761
## 2     3     2      1         5       5         6 -0.467  0.805 -0.847  -1.62
## 3     4     0      0         7       5         6 -0.149 -0.806 -0.0193  0.590
## 4     5     2      0         8       5         6  0.735 -1.63  -0.452  -0.302
## 5     6     5      0         3       1         6 -0.678 -0.300 -1.56    2.04
## 6     7     3      1         7       6         6 -0.467 -1.09  -0.452  -0.302
## # ... with 22 more variables: Cscore <dbl>, Impulsive <dbl>, SS <dbl>,
```

```
## #   Alcohol <dbl>, Amphet <dbl>, Amyl <dbl>, Benzos <dbl>, Caff <dbl>,
## #   Cannabis <dbl>, Choc <dbl>, Coke <dbl>, Crack <dbl>, Ecstasy <dbl>,
## #   Heroin <dbl>, Ketamine <dbl>, Legalh <dbl>, LSD <dbl>, Meth <dbl>,
## #   Mushrooms <dbl>, Nicotine <dbl>, Semer <dbl>, VSA <dbl>
```

```
correlation_matrix <- round(cor(numdrug),2)
head(correlation_matrix)
```

```
##              ID   Age Gender Education Country Ethnicity Nscore Escore Oscore
## ID         1.00 -0.27   0.02     -0.01    0.10      0.01   0.02  -0.05   0.17
## Age       -0.27  1.00  -0.10      0.10   -0.06      0.04  -0.14  -0.03  -0.22
## Gender     0.02 -0.10   1.00     -0.19   -0.02      0.02  -0.07  -0.06   0.13
## Education -0.01  0.10  -0.19      1.00    0.02     -0.08  -0.09   0.11   0.07
## Country    0.10 -0.06  -0.02      0.02    1.00     -0.03   0.05   0.00   0.05
## Ethnicity  0.01  0.04   0.02     -0.08   -0.03      1.00   0.01  -0.04   0.04
##           AScore Cscore Impulsive    SS Alcohol Amphet  Amyl Benzos  Caff
## ID         -0.03  -0.07      0.12  0.16   -0.02   0.17 -0.03   0.16 -0.01
## Age         0.06   0.18     -0.19 -0.33   -0.03  -0.25 -0.11  -0.13  0.04
## Gender     -0.22  -0.18      0.17  0.24    0.00   0.22  0.16   0.13  0.01
## Education   0.08   0.22     -0.12 -0.11    0.13  -0.14  0.00  -0.13  0.04
## Country     0.03  -0.01      0.03  0.01    0.03   0.00 -0.10   0.06  0.03
## Ethnicity   0.00  -0.03      0.00  0.03    0.15   0.06  0.09   0.03  0.13
##           Cannabis  Choc  Coke Crack Ecstasy Heroin Ketamine Legalh   LSD  Meth
## ID            0.21 -0.06  0.09  0.08    0.17   0.09     0.07   0.22  0.21  0.18
## Age          -0.44  0.05 -0.23 -0.06   -0.38  -0.12    -0.22  -0.41 -0.32 -0.19
## Gender        0.30 -0.07  0.18  0.15    0.23   0.14     0.19   0.32  0.28  0.18
## Education    -0.24  0.03 -0.10 -0.15   -0.14  -0.12    -0.06  -0.18 -0.16 -0.16
## Country       0.03  0.02  0.01  0.01   -0.02   0.08    -0.06   0.03 -0.04  0.11
## Ethnicity     0.10  0.07  0.05  0.01    0.06   0.01     0.04   0.06  0.05  0.05
##           Mushrooms Nicotine Semer   VSA
## ID             0.20     0.06  0.05  0.10
## Age           -0.33    -0.25 -0.05 -0.23
## Gender         0.27     0.19 -0.01  0.13
## Education     -0.14    -0.23 -0.04 -0.11
## Country        0.01     0.00 -0.02  0.03
## Ethnicity      0.06     0.08 -0.06  0.00
```

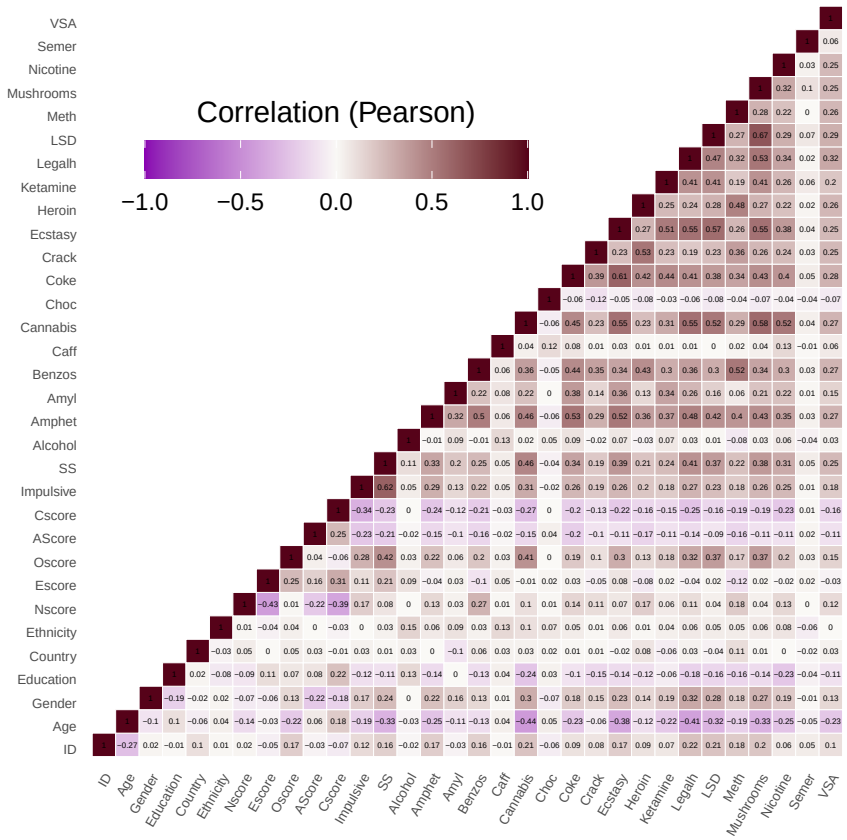
```
  get_upper_tri<-function(correlation_matrix){
    correlation_matrix[lower.tri(correlation_matrix)] <- NA
    return(correlation_matrix)
  }
  upper_tri <- get_upper_tri(correlation_matrix)
library(reshape2)
```

```
##
## Attaching package: 'reshape2'
```

```
## The following object is masked from 'package:tidyr':
##
##     smiths
```

```
melted_cormat <- melt(upper_tri, na.rm = TRUE)
library(ggplot2)
ggplot(data = melted_cormat, aes(Var2, Var1, fill = value))+
 geom_tile(color = "white")+
 scale_fill_gradient2(low = "#8a02b2", high = "#560219", mid = "#FAF9F6",
```

```
   midpoint = 0, limit = c(-1,1), space = "Lab",
   name="Correlation (Pearson)") +
  theme_minimal()+
 theme(axis.text.x = element_text(angle = 60, vjust = 1,
    size = 5, hjust = 1), axis.text.y = element_text(vjust = 1, size = 5, hjust = 1))+
 coord_fixed() +
geom_text(aes(Var2, Var1, label = value), color = "black", size = 1) +
theme(
  axis.title.x = element_blank(),
  axis.title.y = element_blank(),
  panel.grid.major = element_blank(),
  panel.border = element_blank(),
  panel.background = element_blank(),
  axis.ticks = element_blank(),
  legend.justification = c(1, 0),
  legend.position = c(0.6, 0.7),
  legend.direction = "horizontal",
  legend.key.size = unit(0.5, 'cm'))+
  guides(fill = guide_colorbar(barwidth = 10, barheight = 1,
                title.position = "top", title.hjust = 0.5))
```



Visualization Description: This is a heatmap showing the Pearson Correlation of every variable in the dataframe. To create this plot, we created a new dataframe in which all the observations were assigned numerical values as described below.

Age: 0 = 18-24, 1 = 25-34, 2 = 35-44, 3 = 45-54, 4 = 55-64, 5 = 65+

Gender: 0 = F, 1 = M

Education: 0 = Left school before 16 years, 1 = Left school at 16 years, 2 = Left school at 17 years, 3 = Left school at 18 years, 4 = Some college or university, no certificate or degree, 5 = Professional certificate/ diploma, 6 = University degree, 7 = Masters degree, 8 = Doctorate degree

Country: 0 = Australia, 1 = Canada, 2 = New Zealand, 3 = Other, 4 = Republic of Ireland, 5 = UK, 6 = USA

Ethincity: 0 = Asian, 1 = Black, 2 = Mixed-Black/Asian, 3 = Mixed-White/Asian, 4 = Mixed-White/Black, 5 = Other, 6 = White

Then, we found the correlation matrix for the given variables. Finally, we created a heatmap visualization to show the general trends in correlation among variables.

Upon reviewing the visualization, we found that benzodiazepine has a strong positive correlated to neuroticism, extraversion is not heavily correlated to any drug, openness to experience is strongly correlated positively to cannabis use, legal highs, LSD use, and mushroom use, agreeableness and conscientiousness are negatively correlated to all drug use (except for chocolate), and sensation seeking and impulsiveness have the strongest positive correlations to the most drugs.

(code snippets for the heatmap were used from: http://www.sthda.com/english/wiki/ggplot2-quick-correlation-matrix-heatmap-r-software-and-data-visualization)

```
pivoted <- numdrug %>%
  pivot_longer(cols = Alcohol:VSA,
               names_to = "drug_name",
               values_to = "usage_freq")
```

```
pivoted_drug <- pivoted %>%
  pivot_longer(cols = Nscore:SS,
               names_to = "personality",
               values_to = "score")
```

```
pivoted_drug_byfreq <- pivoted_drug %>%
  mutate(x = ifelse(usage_freq >= 3, "Freq", ifelse(usage_freq == 0, "Never", "Rare")))

pivoted_drug_byfreq <- pivoted_drug_byfreq %>%
  dummy_cols(select_columns = c("x"))
```

Create Density Graph: -frequency on x -score on y -for each drug and score combination

-take out semer, chocolate, caffeine