

STAT 411 Final Project

Rebecca Li, Karen Hong

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```
library(ggplot2)
library(dplyr)
```

```
##
## Attaching package: 'dplyr'

## The following objects are masked from 'package:stats':
##
##   filter, lag

## The following objects are masked from 'package:base':
##
##   intersect, setdiff, setequal, union
```

```
library(tidyr)
library(corrplot)
```

```
## Warning: package 'corrplot' was built under R version 4.3.3

## corrplot 0.95 loaded
```

```
library(FactoMineR)
```

```
## Warning: package 'FactoMineR' was built under R version 4.3.3
```

```
library(factoextra)
```

```
## Warning: package 'factoextra' was built under R version 4.3.3

## Welcome! Want to learn more? See two factoextra-related books at https://goo.gl/ve3WBa
```

```
library(psych)
```

```
## Warning: package 'psych' was built under R version 4.3.3

##
## Attaching package: 'psych'
```

```
## The following objects are masked from 'package:ggplot2':  
##  
##    %>%, alpha
```

```
library(corr)
```

```
## Warning: package 'corr' was built under R version 4.3.3
```

```
library(tidyverse)
```

```
## -- Attaching core tidyverse packages ----- tidyverse 2.0.0 --  
## v forcats   1.0.0      v readr     2.1.5  
## v lubridate 1.9.3      v stringr  1.5.1  
## v purrr     1.0.2      v tibble   3.2.1
```

```
## -- Conflicts ----- tidyverse_conflicts() --  
## x psych::%>()      masks ggplot2::%>()  
## x psych::alpha()   masks ggplot2::alpha()  
## x dplyr::filter()  masks stats::filter()  
## x dplyr::lag()     masks stats::lag()  
## i Use the conflicted package (<http://conflicted.r-lib.org/>) to force all conflicts to become errors
```

```
library(candisc)
```

```
## Warning: package 'candisc' was built under R version 4.3.3
```

```
## Loading required package: heplots
```

```
## Warning: package 'heplots' was built under R version 4.3.3
```

```
## Loading required package: broom
```

```
##
```

```
## Attaching package: 'candisc'
```

```
##
```

```
## The following object is masked from 'package:stats':
```

```
##
```

```
##    cancel
```

```
wildfire_data = read.csv("C:/Users/lenovo/Desktop/STAT 411/Final Project/California Wildfire Damage.csv")
```

```
wildfire_data <- wildfire_data %>%  
  mutate(across(where(is.numeric), ~ ifelse(is.na(.), mean(., na.rm = TRUE), .)))
```

```
#PCA
```

```
wildfire_numeric <- wildfire_data %>%  
  select(where(is.numeric))
```

```
wildfire_scaled <- scale(wildfire_numeric)
```

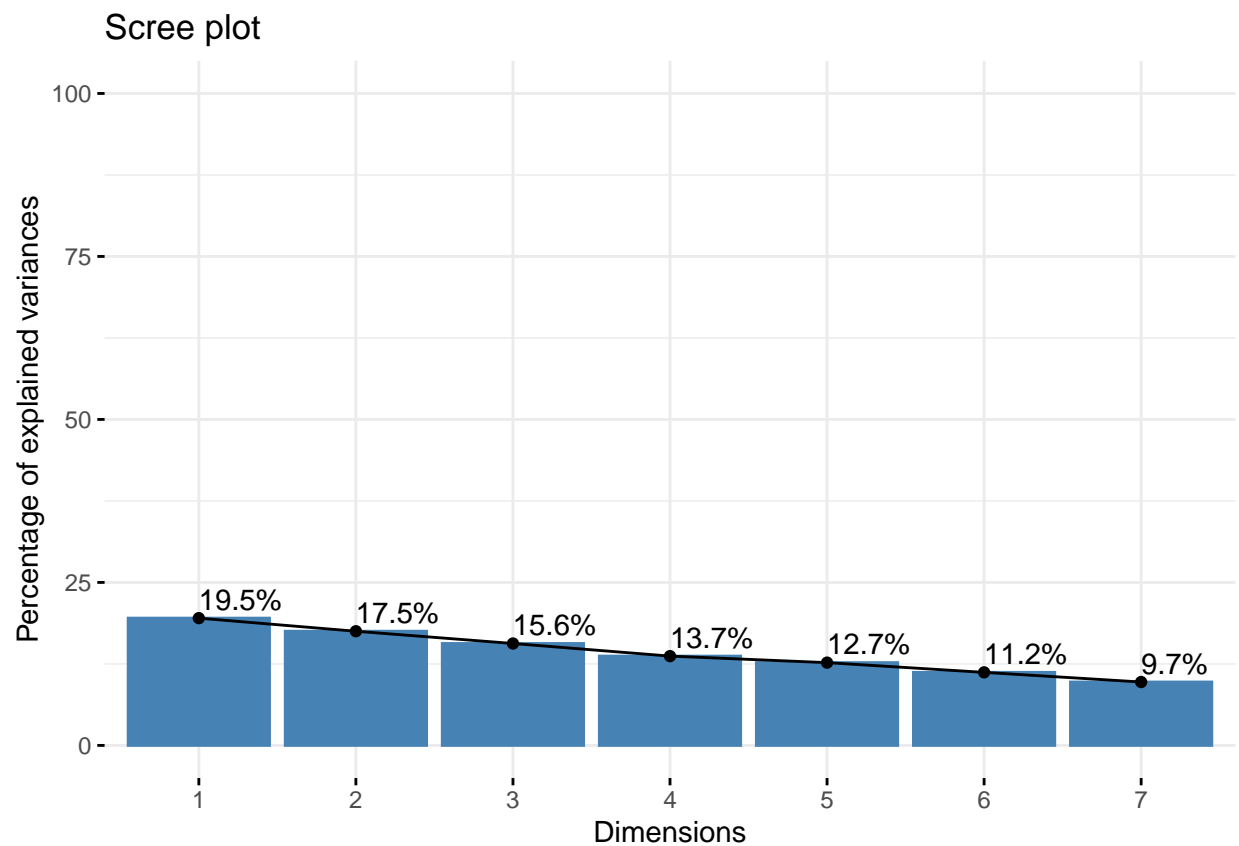
```
pca_result <- prcomp(wildfire_scaled, center = TRUE, scale. = TRUE)
```

```
# Summary of PCA  
summary(pca_result)
```

```
## Importance of components:
```

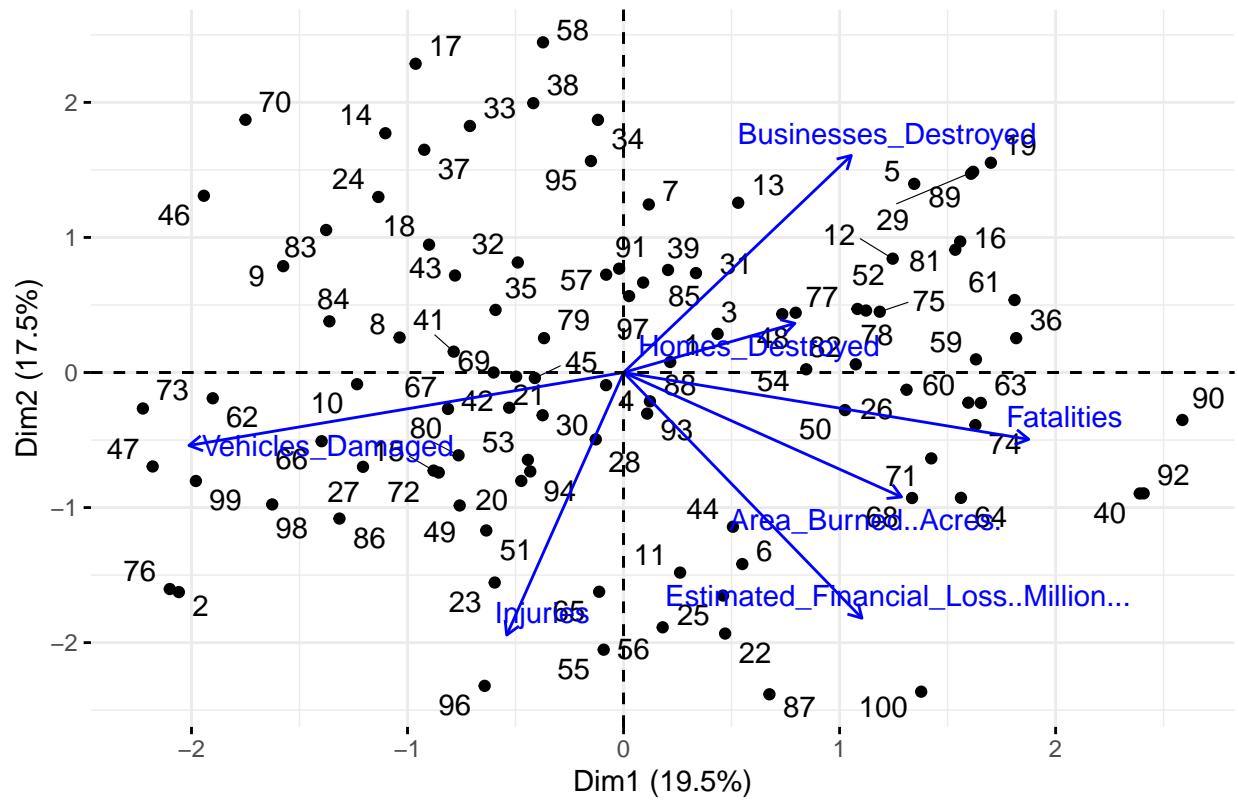
```
##              PC1    PC2    PC3    PC4    PC5    PC6    PC7  
## Standard deviation  1.1690 1.1072 1.0461 0.9792 0.9429 0.8857 0.82520  
## Proportion of Variance 0.1952 0.1751 0.1563 0.1370 0.1270 0.1121 0.09728  
## Cumulative Proportion 0.1952 0.3703 0.5267 0.6637 0.7906 0.9027 1.00000
```

```
fviz_eig(pca_result, addlabels = TRUE, ylim = c(0, 100))
```

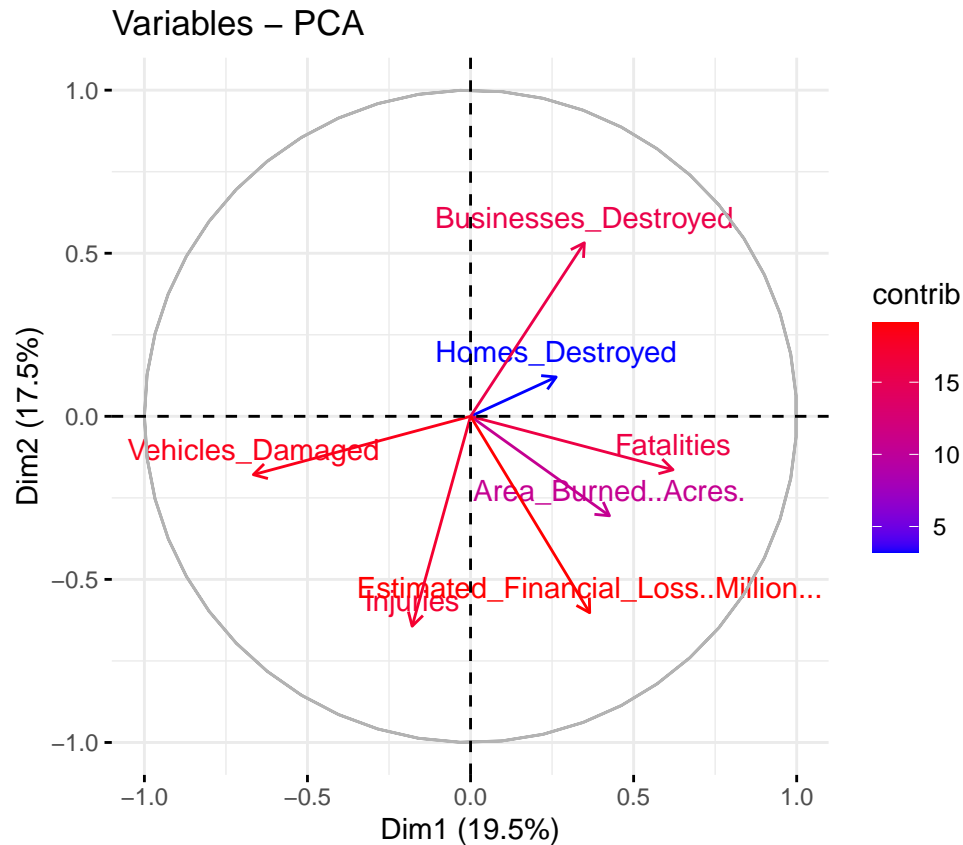


```
fviz_pca_biplot(pca_result, repel = TRUE, col.var = "blue")
```

PCA – Biplot



```
fviz_pca_var(pca_result, col.var = "contrib", gradient.cols = c("blue", "red"))
```



```
pca_scores <- as.data.frame(pca_result$x)
```

```
#Factor Analysis
```

```
data_numeric <- wildfire_data[, c("Area_Burned..Acres.", "Homes_Destroyed",
                                   "Businesses_Destroyed", "Vehicles_Damaged",
                                   "Injuries", "Fatalities", "Estimated_Financial_Loss..Million...")]
data_scaled <- scale(data_numeric)
cor_matrix <- cor(data_scaled)
cor_matrix
```

```
##                               Area_Burned..Acres. Homes_Destroyed
## Area_Burned..Acres.           1.00000000      0.05191504
## Homes_Destroyed                0.05191504      1.00000000
## Businesses_Destroyed           0.02819495      0.11349268
## Vehicles_Damaged              -0.13643198     -0.07311470
## Injuries                       0.09484300      0.01526998
## Fatalities                     0.05039442     -0.04586270
## Estimated_Financial_Loss..Million... 0.07518726      0.04664454
##                               Businesses_Destroyed Vehicles_Damaged
## Area_Burned..Acres.           0.02819495     -0.13643198
## Homes_Destroyed                0.11349268     -0.07311470
## Businesses_Destroyed           1.00000000     -0.07556630
## Vehicles_Damaged              -0.07556630      1.00000000
## Injuries                      -0.10360711      0.11933077
```

```
## Fatalities 0.07356399 -0.17731355
## Estimated_Financial_Loss..Million... -0.07798952 -0.02445021
## Injuries Fatalities
## Area_Burned..Acres. 0.09484300 0.05039442
## Homes_Destroyed 0.01526998 -0.04586270
## Businesses_Destroyed -0.10360711 0.07356399
## Vehicles_Damaged 0.11933077 -0.17731355
## Injuries 1.00000000 -0.03790814
## Fatalities -0.03790814 1.00000000
## Estimated_Financial_Loss..Million... 0.07973711 0.18491923
## Estimated_Financial_Loss..Million...
## Area_Burned..Acres. 0.07518726
## Homes_Destroyed 0.04664454
## Businesses_Destroyed -0.07798952
## Vehicles_Damaged -0.02445021
## Injuries 0.07973711
## Fatalities 0.18491923
## Estimated_Financial_Loss..Million... 1.00000000
```

```
KMO(cor_matrix)
```

```
## Kaiser-Meyer-Olkin factor adequacy
## Call: KMO(r = cor_matrix)
## Overall MSA = 0.5
## MSA for each item =
## Area_Burned..Acres. Homes_Destroyed
## 0.52 0.44
## Businesses_Destroyed Vehicles_Damaged
## 0.50 0.52
## Injuries Fatalities
## 0.50 0.49
## Estimated_Financial_Loss..Million...
## 0.48
```

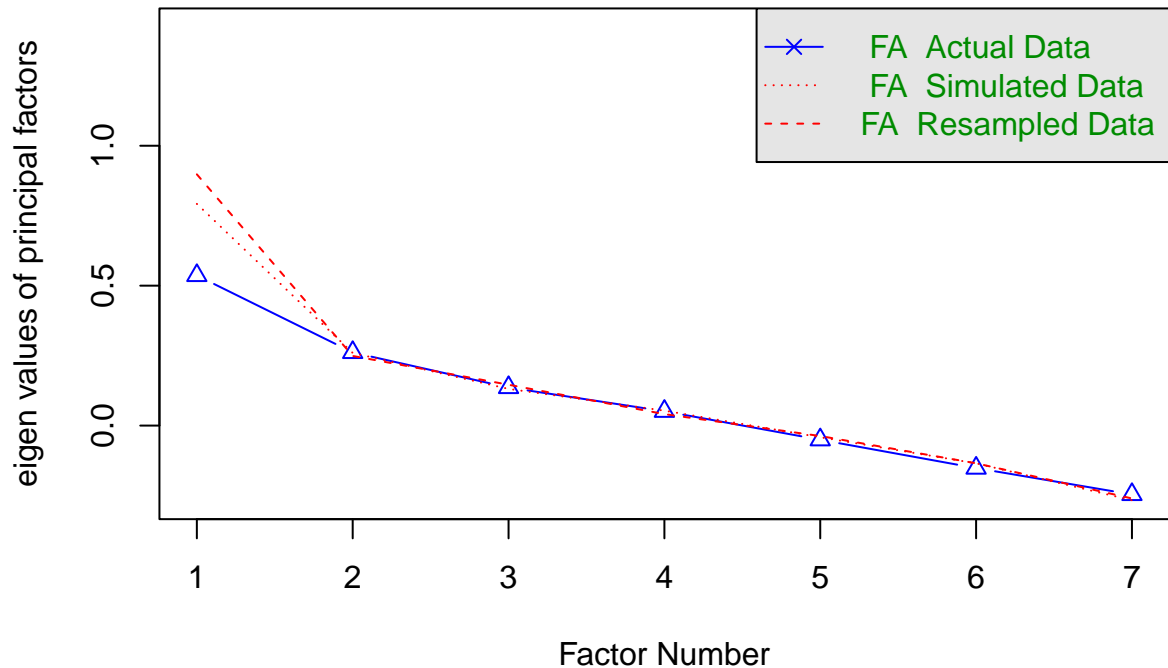
```
cortest.bartlett(cor_matrix)
```

```
## Warning in cortest.bartlett(cor_matrix): n not specified, 100 used
```

```
## $chisq
## [1] 17.30794
##
## $p.value
## [1] 0.6922787
##
## $df
## [1] 21
```

```
# Determine Number of Factors using Scree Plot and Parallel Analysis
fa.parallel(data_scaled, fm="ml", fa="fa")
```

Parallel Analysis Scree Plots



```
## Parallel analysis suggests that the number of factors = 0 and the number of components = NA
```

```
fa_result <- fa(data_scaled, nfactors=2, fm="ml", rotate="varimax")
```

```
#Factor loading
fa_result$loadings
```

```
##
## Loadings:
##
##          ML1    ML2
## Area_Burned...Acres.    -0.177
## Homes_Destroyed        -0.101
## Businesses_Destroyed   -0.162
## Vehicles_Damaged       0.667
## Injuries               0.169
## Fatalities             0.186 -0.258
## Estimated_Financial_Loss..Million... 0.997
##
##          ML1    ML2
## SS loadings  1.051 0.608
## Proportion Var 0.150 0.087
## Cumulative Var 0.150 0.237
```

```
# Compute Factor Scores
factor_scores <- factor.scores(data_scaled, fa_result)
print("Factor Scores:")
```

```
## [1] "Factor Scores:"
```

```
print(factor_scores$scores)
```

```
##           ML1           ML2
## [1,] -0.088005569  0.561978119
## [2,] -0.712070670  1.657004597
## [3,]  0.019525900 -1.020083821
## [4,]  1.095666671 -0.647746453
## [5,] -0.415199339 -0.717814427
## [6,]  1.442288265 -0.872403982
## [7,] -1.173733834 -0.940345314
## [8,] -0.277192718  0.058547852
## [9,] -0.970504101  0.820079612
## [10,]  0.148151802  0.504474572
## [11,]  0.095770860 -0.099149158
## [12,] -0.531395326 -1.155435807
## [13,] -1.601772039 -1.459394416
## [14,] -1.118056128  0.852476364
## [15,] -0.635598358  1.442960355
## [16,]  0.827387865 -1.401016118
## [17,] -1.030102177  0.663040774
## [18,] -1.488556233  0.924317965
## [19,] -1.248641934 -1.841350337
## [20,] -1.484894068 -0.720776778
## [21,] -0.493562991  0.406565766
## [22,]  0.247238742 -0.735008059
## [23,]  1.163238506  1.088200324
## [24,] -0.615805587  0.307637200
## [25,]  1.726632514  0.814700611
## [26,]  0.782203919 -0.526659193
## [27,] -0.388967706  0.517015339
## [28,]  0.387736438  0.284621910
## [29,] -0.290759071 -1.486210648
## [30,] -0.454757049  0.419469948
## [31,] -1.222901097 -0.135596128
## [32,] -1.168419446 -0.086918116
## [33,] -1.220002436 -0.491329640
## [34,] -0.707125720 -0.334195515
## [35,] -0.590952256  0.756512329
## [36,]  0.881727996 -0.843949218
## [37,] -0.993057427  0.476600637
## [38,] -0.522391638  0.496026578
## [39,] -1.473002747 -0.204972423
## [40,]  1.260065003 -1.128102596
## [41,] -1.548548656  0.316231056
## [42,]  1.207158963  1.129900009
## [43,] -0.260053454 -0.151447984
## [44,]  1.189603491 -0.825108629
```



```

## [45,] 0.976101837 1.347326265
## [46,] -0.768048335 1.569647580
## [47,] 0.676851401 1.919921257
## [48,] 0.761630662 -0.694797036
## [49,] 0.703546347 1.237197971
## [50,] 0.595103823 -0.847259785
## [51,] 0.680675727 1.473888712
## [52,] 1.570639601 -0.137116011
## [53,] -0.857426983 0.352773731
## [54,] 1.020588655 -0.321280243
## [55,] 1.317372416 0.434019265
## [56,] 1.698728772 1.057012146
## [57,] -0.646822851 0.781316382
## [58,] -0.997666091 -0.514226691
## [59,] 0.131959665 -1.148280630
## [60,] 0.849393757 -1.535400987
## [61,] -0.180290769 -1.356205794
## [62,] -1.616585504 0.898056104
## [63,] 0.709989491 -0.835978901
## [64,] 1.203560022 -1.227568260
## [65,] 1.392707914 0.923406322
## [66,] -1.280315246 1.101657650
## [67,] 0.665208498 1.168395464
## [68,] 0.003153045 -0.790835195
## [69,] 0.696356015 1.279506847
## [70,] -1.486487954 0.045584568
## [71,] 1.075624129 -0.942295584
## [72,] 0.912132543 1.214139549
## [73,] -0.413628587 1.489303699
## [74,] 0.692476062 -1.063523076
## [75,] 1.175363288 -0.959979300
## [76,] 0.485220353 1.920634268
## [77,] 0.416076314 -1.394315068
## [78,] 0.774414060 -1.069171499
## [79,] -1.637702476 -0.095936189
## [80,] -0.756436677 0.646574109
## [81,] 0.903796235 -1.510445805
## [82,] -1.566541243 -1.468241959
## [83,] -0.584736798 1.052954018
## [84,] -0.853808877 0.721711097
## [85,] -0.795043216 -0.476027915
## [86,] 0.953986175 1.291308607
## [87,] 1.158745826 -0.518868745
## [88,] 0.539844845 0.594906525
## [89,] -0.905316463 -1.559688454
## [90,] 1.167217021 -1.409936164
## [91,] -1.381685874 -0.946479401
## [92,] 1.467597419 -1.576445011
## [93,] 0.317128384 -0.080374895
## [94,] 1.475395019 0.439055197
## [95,] -1.210365181 -0.549841210
## [96,] 1.126201647 1.520074632
## [97,] -1.410617290 0.004997727
## [98,] -0.643906019 -0.163309919

```

```
## [99,] 0.632743589 2.041196488
## [100,] 1.317534712 -0.006083609
```