BIO247 Exam 1

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09/29/22

Part 1 - Written

Problem 1

Being robust is being able to change any variables but the experiment is still able to work. Robustness is not definitive and can be narrow or wide depending upon how transferable the experiment guidelines are. Sharing code and commenting on it to make it readable for humans is also part of being robust.

Being reproducible means that the experiment has clearly described protocol that can be easily followed and conducted by others. In order to be reproducible, one should share their script used or at least supply a benchmark to reference as well. Clearly stating how things were done and why they were makes an experiment reproducible.

Problem 2

This problem has been drawn on the last page of the exam.

Problem 3

This conservation study is not reproducible because it does not give a clear procedure and is vague in its description. Also, the experiment itself is not sound due to the fact that they're asking a hypothetical question on how someone would behave in a situation, but their response could be far from the truth had the participants actually encountered the snake. As for robustness, one could argue that this is not robust because the age group of participants is not wide and is in fact limited to only undergraduate students. This experiemnt then is very limited in its reach.

Problem 4

This bioinformatics study is robust and reproducible. It is robust and reproducible becasue it uses data accessed from open-source technologies in R programming languages which means that data for this can be easily (for the most part) accessed by others who wish to do this with different variables. Going off of that, the variables can easily be changed to something else and we could get viable results. They included where they got all of their data from and what programming they used for steps. This study includes well laid out steps that could be followed by others and apply under different variables.

Part 2 - Practical

Problem 5

This is a coding diagram beneath the chunk because I am unsure of the code to conduct this.

```
interact <- rep("interactions",25)
```

Use If/Else Loop to say if interactions are positive/negative and then print the suffix

Find the positive and negatives

Vectorize the suffixes that are negative

Vectorize the suffixes that are positive

Use the paste function

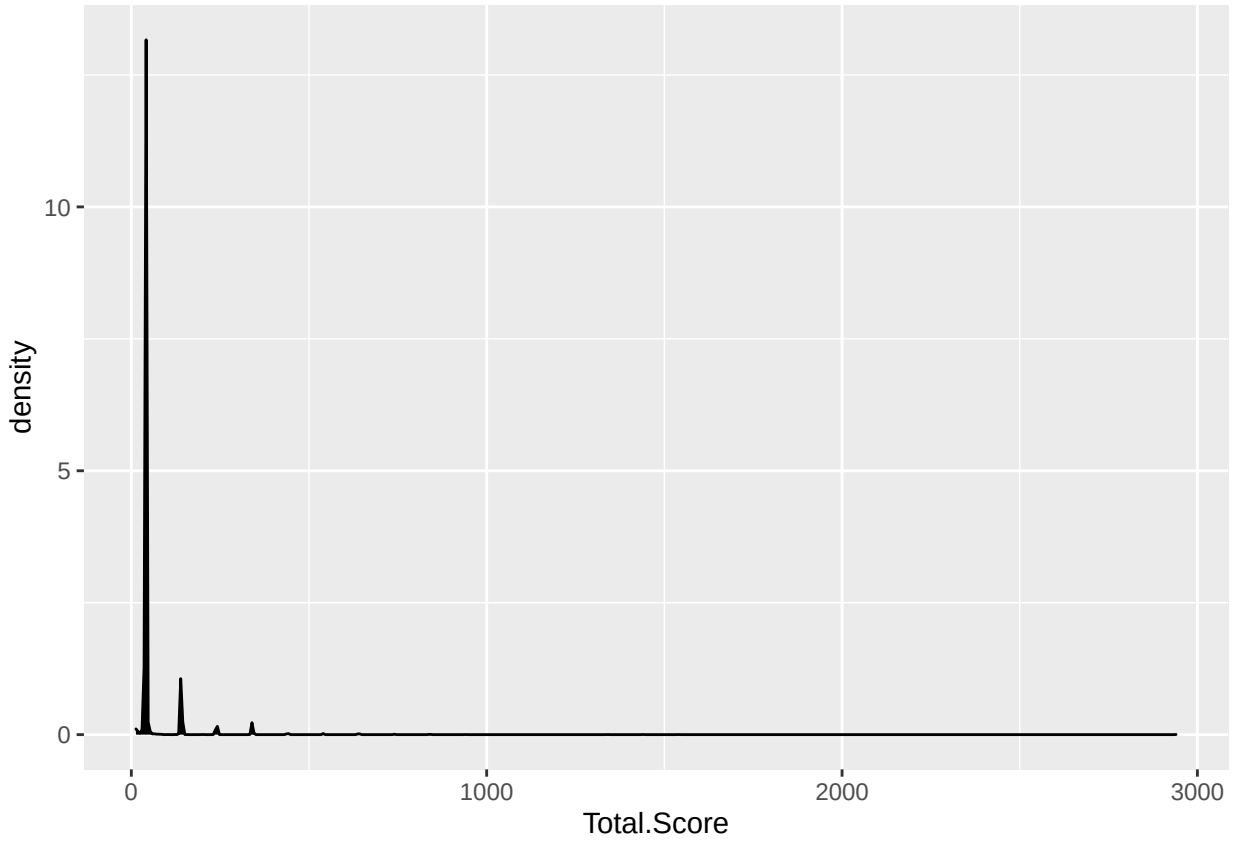
Problem 6

This is importing the dataset and installing the ggplot package in order to create a density plot.

```
GBM_data <- read.csv("/cloud/project/GBM_data.csv")
install.packages("ggplot2")
```

```
## Installing package into '/cloud/lib/x86_64-pc-linux-gnu-library/4.2'
## (as 'lib' is unspecified)
```

```
library(ggplot2)
ggplot(GBM_data)+geom_density(aes(x=Total.Score),fill="black")
```



Problem 7

subsetting the rows to the top 100 interactions only.

```
GBM_data[1:100,]
```

```
##        X Element.Name    Element.Type    Database           PosReg.Name
## 1   2184         egfr         protein      p00533                    pm
```

```
## 2   2188        egfr         protein      p00533                   sd
## 3   5045          rb                                               p38
## 4   4989         ras          family     pf00071
## 5   4994         ras          family     pf00071
## 6    201         akt          family         akt
## 7   2174        egfr         protein      p00533                 ano1
## 8   3930         mrn         protein      o60934
## 9   3661         map         protein      p12872
## 10  2293         erk          family         erk
## 11   203         akt          family         akt
## 12   211         akt          family         akt                 atra
## 13   177         akt          family         akt
## 14   242         akt          family         akt                 p110
## 15   204         akt          family         akt
## 16  4996         ras          family     pf00071
## 17  2094        e2f1         protein      q01094
## 18  4285         p53         protein      p04637
## 19  4291         p53         protein      p04637
## 20   144         akt
## 21  2307         erk          family         erk               insulin
## 22  4625        pi3k         protein        pi3k               insulin
## 23  4200         p21         protein      p38936
## 24  2312         erk          family         erk                 pmek
## 25  4288         p53         protein      p04637
## 26  1107   caspase-9         protein      p55211         cytochrome c
## 27  6032        vegf         protein      p15692                vgpcr
## 28  3663         map         protein      p12872            integrin
## 29  3714        mdm2         protein      q00987
## 30  4306         p53         protein      p04637                 etv1
## 31  4634        pi3k         protein        pi3k                 rtks
## 32  2346          es simple-chemical     6995653
## 33  4322         p53         protein      p04637                 tert
## 34  5005         ras          family     pf00071                grb10
## 35  1142        cd44         protein      p16070
## 36  3723        mdm2         protein      q00987                 daxx
## 37  3664         map         protein      p12872           integrin-
## 38  3715        mdm2         protein      q00987
## 39  4992         ras          family     pf00071
## 40  4275         p53         protein      p04637
## 41  3980        mtor         protein      p42345                vgpcr
## 42   212         akt          family         akt                 bmi1
## 43  4635        pi3k         protein        pi3k                runx2
## 44  2169        egfr         protein      p00533
## 45   219         akt          family         akt          doxorubicin
## 46   186         akt          family         akt
## 47   196         akt          family         akt
## 48   195         akt          family         akt
## 49  4609        pi3k         protein        pi3k                 atra
## 50  4919        pten         protein      p60484       pi3k inhibitors
## 51  3972        mtor         protein      p42345
## 52   146         akt
## 53   150         akt
## 54   151         akt
## 55   157         akt                                              bdnf
```

```
## 56   161          akt                                                 igf-i
## 57   163          akt                                                  il-3
## 58   181          akt          family         akt
## 59   185          akt          family         akt
## 60   225          akt          family         akt growth factor receptor
## 61   187          akt          family         akt
## 62  4626         pi3k         protein        pi3k               integrin
## 63  4632         pi3k         protein        pi3k                   rac1
## 64   224          akt          family         akt                    fbs
## 65   253          akt          family         akt             resveratrol
## 66   228          akt          family         akt                    hdl
## 67  4641         pi3k         protein        pi3k                    tsc
## 68  4223          p27         protein      p40305
## 69  5056           rb         protein      p06400
## 70  5059           rb         protein      p06400
## 71  6022         vegf         protein      p15692
## 72  4905         pten         protein      p60484
## 73  4902         pten         protein      p60484
## 74  5120          rb1         protein      p06400
## 75  4409        parp1         protein      p09874
## 76  5333          shc         protein      p29353              t antigen
## 77  2708         fkhr         protein      q12778
## 78  2756       foxo1a         protein      q12778
## 79  5168         rheb         protein      q15382                insulin
## 80  5261         s6k1         protein      p23443
## 81  5185          ros simple-chemical chebi:26523
## 82  5940      tuberin         protein      p49815
## 83  5914         tsc2         protein      p49815
## 84  5194          ros simple-chemical chebi:26523               selenite
## 85  4224          p27         protein      p40305
## 86  5054           rb         protein      p06400
## 87  1047           ca simple-chemical         271                  snare
## 88  4237          p27         protein      p40305              ubiquitin
## 89   234          akt          family         akt                insulin
## 90  2655          fas         protein      p25445
## 91   251          akt          family         akt              rapamycin
## 92   255          akt          family         akt                  runx2
## 93   256          akt          family         akt                  sr-bi
## 94  5035           rb
## 95  3029        hif-1         protein        hif1         pi3k inhibitor
## 96  4235          p27         protein      p40305                   scf
## 97  5048           rb                                             tigar
## 98  4233          p27         protein      p40305             proteasome
## 99  5041           rb                                            cyclin
## 100 4229          p27         protein      p40305                   e3
##         PosReg.Type       PosReg.ID X.1     NegReg.Name     NegReg.Type
## 1   simple-chemical            1052  NA
## 2           protein          p46060  NA
## 3            family             p38  NA
## 4                                     NA           grb10         protein
## 5                                     NA             nf1         protein
## 6                                     NA            pten         protein
## 7           protein          q5xxa6  NA
## 8                                     NA            atrx         protein
```

```
## 9                                    NA            pten         protein
## 10                                   NA    atorvastatin simple-chemical
## 11                                   NA     resveratrol simple-chemical
## 12 simple-chemical           44795  NA
## 13                                   NA    atorvastatin simple-chemical
## 14          family       pi3k_p110  NA
## 15                                   NA        selenite simple-chemical
## 16                                   NA            pten         protein
## 17                                   NA           kdm2a         protein
## 18                                   NA            mdm2         protein
## 19                                   NA         slc12a5         protein
## 20                                   NA        ly294002 simple-chemical
## 21         protein          p01308  NA
## 22         protein          p01308  NA
## 23                                   NA         slc12a5         protein
## 24         protein        uaz07614  NA
## 25                                   NA          pike-a         protein
## 26         protein          p99999  NA
## 27         protein          q98146  NA
## 28         protein          p08648  NA
## 29                                   NA             akt          family
## 30         protein          p50549  NA
## 31         protein        uaz00058  NA
## 32                                   NA             pml         protein
## 33         protein          o14746  NA
## 34         protein          q13322  NA
## 35                                   NA              rb         protein
## 36         protein          q9uer7  NA
## 37         protein          p08648  NA
## 38                                   NA             arf         protein
## 39                                   NA   neurofibromin         protein
## 40                                   NA             akt          family
## 41         protein          q98146  NA
## 42         protein          p35226  NA
## 43         protein          q13950  NA
## 44                                   NA             cas         protein
## 45 simple-chemical        40469134  NA
## 46                                   NA        kp-372-2         protein
## 47                                   NA            p110          family
## 48                                   NA            nqo2         protein
## 49 simple-chemical           44795  NA
## 50 simple-chemical        uaz00013  NA
## 51                                   NA       rapamycin simple-chemical
## 52                                   NA            p110          family
## 53                                   NA            pten         protein
## 54                                   NA       rapamycin
## 55         protein          p23560  NA
## 56         protein          p05019  NA
## 57         protein          p08700  NA
## 58                                   NA egfr inhibitors simple-chemical
## 59                                   NA        kp-372-1         protein
## 60         protein ua-bp-ggp-00052  NA
## 61                                   NA         kp372-1         protein
## 62         protein          p08648  NA
```

```
## 63          protein          p63000  NA
## 64          protein          q9hah7  NA
## 65  simple-chemical          445154  NA
## 66          protein             hdl  NA
## 67           family             tsc  NA
## 68                                   NA             abl         protein
## 69                                   NA            e2f3         protein
## 70                                   NA            hdm2         protein
## 71                                   NA        ly294002 simple-chemical
## 72                                   NA          foxo1a         protein
## 73                                   NA            bmi1         protein
## 74                                   NA            cdk4         protein
## 75                                   NA        arsenite simple-chemical
## 76  simple-chemical         6857385  NA
## 77                                   NA         insulin         protein
## 78                                   NA            pi3k         protein
## 79          protein          p01308  NA
## 80                                   NA         tuberin         protein
## 81                                   NA            idh1         protein
## 82                                   NA             akt          family
## 83                                   NA             akt          family
## 84  simple-chemical            1090  NA
## 85                                   NA             bcr         protein
## 86                                   NA            e2f1         protein
## 87           family         pf05739  NA
## 88          protein          p0cg47  NA
## 89          protein          p01308  NA
## 90                                   NA pi3k inhibitors simple-chemical
## 91  simple-chemical         5284616  NA
## 92          protein          q13950  NA
## 93          protein          q8wtv0  NA
## 94                                   NA            pp1c          family
## 95  simple-chemical        uaz00019  NA
## 96          protein          p21583  NA
## 97          protein          q9nq88  NA
## 98          protein      proteasome  NA
## 99          protein          p12004  NA
## 100 simple-chemical            5756  NA
##     NegReg.ID X.2 Connection.Type
## 1              NA               i
## 2              NA               i
## 3              NA               i
## 4       q13322  NA               i
## 5       p21359  NA               i
## 6       p60484  NA               i
## 7              NA               i
## 8       p46100  NA               i
## 9       p60484  NA               i
## 10       60823  NA               i
## 11      445154  NA               i
## 12             NA               i
## 13       60823  NA               i
## 14             NA               i
## 15        1090  NA               i
```

```
## 16     p60484  NA              i
## 17     q9y2k7  NA              i
## 18     q00987  NA              i
## 19     q9h2x9  NA              i
## 20       3973  NA              i
## 21             NA              i
## 22             NA              i
## 23     q9h2x9  NA              i
## 24             NA              i
## 25   uaz09795  NA              i
## 26             NA              i
## 27             NA              i
## 28             NA              i
## 29        akt  NA              i
## 30             NA              i
## 31             NA              i
## 32     p29590  NA              i
## 33             NA              i
## 34             NA              i
## 35     p06400  NA              i
## 36             NA              i
## 37             NA              i
## 38     q8n726  NA              i
## 39     p21359  NA              i
## 40        akt  NA              i
## 41             NA              i
## 42             NA              i
## 43             NA              i
## 44     o60716  NA              i
## 45             NA              i
## 46   uaz07773  NA              i
## 47  pi3k_p110  NA              i
## 48     p16083  NA              i
## 49             NA              i
## 50             NA              i
## 51    5284616  NA              i
## 52  pi3k_p110  NA              i
## 53     p60484  NA              i
## 54    5284616  NA              i
## 55             NA              i
## 56             NA              i
## 57             NA              i
## 58   uaz00082  NA              i
## 59   uaz00147  NA              i
## 60             NA              i
## 61   uaz00147  NA              i
## 62             NA              i
## 63             NA              i
## 64             NA              i
## 65             NA              i
## 66             NA              i
## 67             NA              i
## 68     p00519  NA              i
## 69     o00716  NA              i
```

```
## 70     q00987  NA              i
## 71       3973  NA              i
## 72     q12778  NA              i
## 73     p35226  NA              i
## 74     p11802  NA              i
## 75    6857431  NA              i
## 76             NA              i
## 77     p01308  NA              i
## 78       pi3k  NA              i
## 79             NA              i
## 80     p49815  NA              i
## 81     o75874  NA              i
## 82        akt  NA              i
## 83        akt  NA              i
## 84             NA              i
## 85     p11274  NA              i
## 86     q01094  NA              i
## 87             NA              i
## 88             NA              i
## 89             NA              i
## 90   uaz00013  NA              i
## 91             NA              i
## 92             NA              i
## 93             NA              i
## 94      ppp1c  NA              i
## 95             NA              i
## 96             NA              i
## 97             NA              i
## 98             NA              i
## 99             NA              i
## 100            NA              i
##
## 1   [' ', ' ', ' ', ' ', ' ', ' ', ' ', ' ', ' ', ' ', ' ', ' ', ' ', ' ', ' ', ' ', ' ', ' ', ' ', ' ', ' ', ' ',
## 2                                                                                                 [' ', ' ', ' ', ' ', ' ',
## 3                                                                                                      [' ', ' ', ' ', ' ',
## 4     ['uniprot', 'uniprot', 'uniprot', 'uniprot', 'uniprot', 'uniprot', 'uniprot', 'uniprot', 'unipr
## 5                                                  ['uniprot', 'uniprot', 'uniprot', 'uniprot', 'unipr
## 6                                                            ['uniprot', 'uniprot', 'uniprot', 'unipr
## 7
## 8                                                            ['uniprot', 'uniprot', 'uniprot', 'unipr
## 9                                                                      ['uniprot', 'uniprot', 'unipr
## 10                                                                     ['pubchem', 'pubchem', 'pubch
## 11                                                                     ['pubchem', 'pubchem', 'pubch
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## 15                                                                                 ['pubchem', 'pubch
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## 17                                                                                 ['uniprot', 'unipr
## 18                                                                                 ['uniprot', 'unipr
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##
## 1   ['activation', 'activation', 'activation', 'activation', 'activation', 'activation', 'activation
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## 1   ['pmc3440385', 'pmc3440385', 'pmc3440385', 'pmc3440385', 'pmc3440385', 'pmc3440385', 'pmc3440385
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##
## 1   ['pm activation of egfr is achieved by activation of endocytosis deficient mutant egfr1010ll/aa s
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```

```
## 98
## 99
## 100
##     Evidence.Score Match.Score Kind.Score Epistemic.Value Total.Score
## 1               29         100         40               1        2940
## 2               15         100         40               1        1540
## 3               14         100         40               1        1440
## 4               13         100         40               1        1340
## 5                9         100         40               1         940
## 6                8         100         40               1         840
## 7                8         100         40               1         840
## 8                8         100         40               1         840
## 9                7         100         40               1         740
## 10               7         100         40               1         740
## 11               7         100         40               1         740
## 12               6         100         40               1         640
## 13               6         100         40               1         640
## 14               6         100         40               1         640
## 15               6         100         40               1         640
## 16               6         100         40               1         640
## 17               6         100         40               1         640
## 18               6         100         40               1         640
## 19               6         100         40               1         640
## 20               6         100         40               1         640
## 21               6         100         40               1         640
## 22               5         100         40               1         540
## 23               5         100         40               1         540
## 24               5         100         40               1         540
## 25               5         100         40               1         540
## 26               5         100         40               1         540
## 27               5         100         40               1         540
## 28               5         100         40               1         540
## 29               5         100         40               1         540
## 30               4         100         40               1         440
## 31               4         100         40               1         440
## 32               4         100         40               1         440
## 33               4         100         40               1         440
## 34               4         100         40               1         440
## 35               4         100         40               1         440
## 36               4         100         40               1         440
## 37               4         100         40               1         440
## 38               4         100         40               1         440
## 39               4         100         40               1         440
## 40               4         100         40               1         440
## 41               4         100         40               1         440
## 42               3         100         40               1         340
## 43               3         100         40               1         340
## 44               3         100         40               1         340
## 45               3         100         40               1         340
## 46               3         100         40               1         340
## 47               3         100         40               1         340
## 48               3         100         40               1         340
## 49               3         100         40               1         340
## 50               3         100         40               1         340
```

```
## 51              3         100          40              1         340
## 52              3         100          40              1         340
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## 54              3         100          40              1         340
## 55              3         100          40              1         340
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## 58              3         100          40              1         340
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## 60              3         100          40              1         340
## 61              3         100          40              1         340
## 62              3         100          40              1         340
## 63              3         100          40              1         340
## 64              3         100          40              1         340
## 65              3         100          40              1         340
## 66              3         100          40              1         340
## 67              3         100          40              1         340
## 68              3         100          40              1         340
## 69              3         100          40              1         340
## 70              3         100          40              1         340
## 71              3         100          40              1         340
## 72              3         100          40              1         340
## 73              3         100          40              1         340
## 74              3         100          40              1         340
## 75              3         100          40              1         340
## 76              3         100          40              1         340
## 77              3         100          40              1         340
## 78              3         100          40              1         340
## 79              3         100          40              1         340
## 80              3         100          40              1         340
## 81              3         100          40              1         340
## 82              3         100          40              1         340
## 83              3         100          40              1         340
## 84              3         100          40              1         340
## 85              3         100          40              1         340
## 86              3         100          40              1         340
## 87              3         100          40              1         340
## 88              3         100          40              1         340
## 89              3         100          40              1         340
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## 91              3         100          40              1         340
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## 97              3         100          40              1         340
## 98              3         100          40              1         340
## 99              3         100          40              1         340
## 100             3         100          40              1         340
```

I chose to do the top 100 interactions because the density plot doesn't give me a clear indication of the number at which it changes, so instead I chose to focus on the top 100 interactions which would be the smaller humps on the density graph. By focusing on these as my threshold, I am narrowing down the data I

am looking at and instead observing the top scored interactions.

Problem 8

This is subbing out the special characters and then unlisting the IDs so that the unique ones can be counted in the dataset. Part of this solution was sourced from the RMD created for Lab4/ Lab4 Code.

```
GBM_data$Paper.ID <-gsub("\\[","",GBM_data$Paper.ID)
GBM_data$Paper.ID <-gsub("\\`","",GBM_data$Paper.ID)
GBM_data$Paper.ID <-gsub("\\]","",GBM_data$Paper.ID)
GBM_data$Paper.ID <-gsub(" ","",GBM_data$Paper.ID)
unique(unlist(GBM_data$Paper.ID))
```

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