MINDGAME INSIGHTS

A DEEP DIVE INTO GAMING AND PSYCHOLOGICAL WELL-BEING RELATIONSHIPS

COURSE: INST 737 - INTRODUCTION TO DATA SCIENCE

MILESTONE 3

TEAM:

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RESEARCH QUESTION

- **Dependent Variable**

Generalized Anxiety Disorder ***(GAD_T)***

- **Independent Variables**

Narcissism, Social Phobia Inventory ***(SPIN_T)****, Hours, Satisfaction With Life* ***(SWL_T)****, Reasons to Play* ***(whyplay_clean)****, Status of Work* ***(Work)****, Style of Play* ***(Playstyle_clean)***

THE RECAP

MILESTONE 1

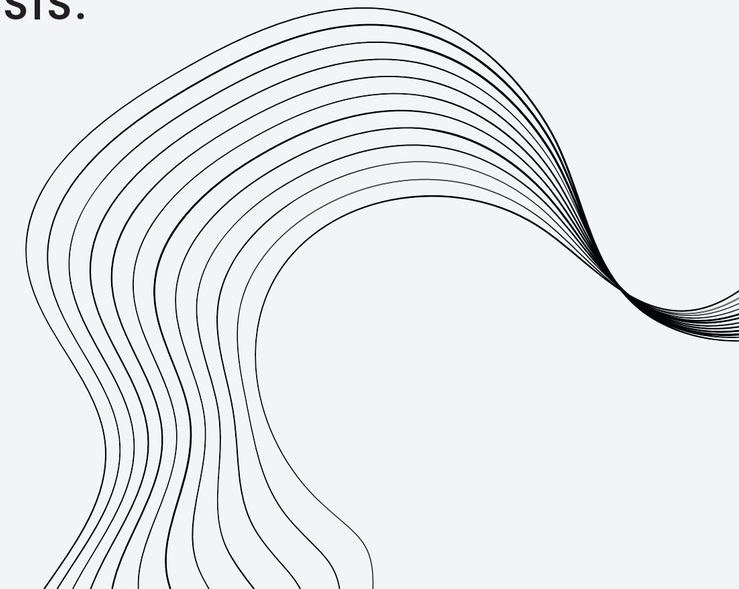
- In Milestone 1, we conducted preliminary data cleaning and performed Exploratory Data Analysis of our dataset.

MILESTONE 2

- In Milestone2, We explored various regression and classification models, experimented with Decision Trees with ensemble methods like Bagging and Random Forests. and ending up with a comparative analysis of all the models used.

MILESTONE 3

FOR MILESTONE 3, WE TRAINED AND TESTED VARIOUS SVM MODELS, EXPLORED THE APPLICABILITY OF NEURAL NETWORKS FOR OUR RESEARCH QUESTION AND INCORPARATED VARIOUS CLUSTERING TECHNIQUES AND REPORTED RELEVANT STATISTICS. FURTHERMORE, WE PERORMED A COMPARATIVE ANALYSIS AND APPLIED FEATURE SELECTION TO FEW OF MODELS FROM MILESTONE 2 AND MILESTONE 3. FINALLY, WE HAVE ALSO EXPLORED THE POTENTIAL ETHICAL IMPLICATIONS OF OUR RESAECH HYPOTHESIS.



SVM (STATE VECTOR MACHINES)

OUR APPROACH

FOR OUR HYPOTHESIS, WE TREATED ANXIETY LEVELS (GAD_T) AS A CATEGORICAL VARIABLE, USING A ONE-VS-ONE SVM CLASSIFICATION MODEL RATHER THAN A NUMERICAL VARIABLE AND TREATING IT AS A REGRESSION PROBLEM.

DATA PRE-PROCESSING

WE THEN IMPORTED THE DATASET, SELECTED RELEVANT COLUMNS, CONVERTED GAD_T INTO A FACTOR, AND SPLIT THE DATA INTO AN 80-20 TRAINING AND TESTING SET FOR OUR MODEL PREDICTION.

SVM (STATE VECTOR MACHINES)

MODEL TRAINING & EVALUATION

HERE ARE THE SUMMARY OF KERNELS THAT WERE USED FOR OUR RESEARCH HYPOTHESIS:

Kernel Type	Support Vectors	Training Error	Overall Accuracy
Gaussian	8420	*79.22%*	*14.35%*
Polynomial	8372	*84.39%*	*12.56%*
Euclidean	8372	*84.42%*	*12.65%*
Hyperbolic Tanget	8310	*89.22%*	*11.90%*

NOTE: ALTHOUGH, ALL THE KERNELS DID SHOW A LIMITED PERFORMANCE FOR OUR DATASET, GAUSSIAN KERNEL (‘RBFDOT’) WAS THE BEST AMONG THE LOT.

SVM (STATE VECTOR MACHINES)

CLASS-WISE STATISTICS OF EACH KERNEL

1.GAUSSIAN KERNEL

Statistics by Class:

	Class: 0	Class: 1	Class: 2	Class: 3	Class: 4	Class: 5	Class: 6	Class: 7	Class: 8	Class: 9	Class: 10	Class: 11
Sensitivity	0.52823	0.13744	0.20147	0.19383	0.081218	0.037500	0.066176	0.032787	0.027778	0.00000	0.000000	0.0200000
Specificity	0.76043	0.88568	0.81355	0.78265	0.941697	0.968335	0.955096	0.982966	0.985572	1.00000	0.994645	0.9990329
Pos Pred Value	0.22625	0.11741	0.13784	0.09670	0.125000	0.088235	0.091837	0.105263	0.093750	NaN	0.000000	0.3333333
Neg Pred Value	0.92398	0.90273	0.87318	0.88996	0.909045	0.924878	0.937129	0.943269	0.949664	0.96364	0.969625	0.9768322
Prevalence	0.11709	0.09962	0.12890	0.10718	0.093012	0.075543	0.064212	0.057602	0.050992	0.03636	0.030217	0.0236072
Detection Rate	0.06185	0.01369	0.02597	0.02077	0.007554	0.002833	0.004249	0.001889	0.001416	0.00000	0.000000	0.0004721
Detection Prevalence	0.27337	0.11662	0.18839	0.21483	0.060434	0.032106	0.046270	0.017941	0.015109	0.00000	0.005194	0.0014164
Balanced Accuracy	0.64433	0.51156	0.50751	0.48824	0.511458	0.502918	0.510636	0.507876	0.506675	0.50000	0.497322	0.5095164

	class: 12	class: 13	class: 14	class: 15	class: 16	class: 17	class: 18	class: 19	class: 20	class: 21
Sensitivity	0.0476190	0.065217	0.0000000	0.00000	0.00000	0.000000	0.00000	0.000000	0.000000	0.0500000
Specificity	0.9913295	0.985521	0.9995208	1.00000	1.00000	1.000000	1.00000	1.000000	1.000000	0.9976168
Pos Pred Value	0.1000000	0.090909	0.0000000	NaN	NaN	NaN	NaN	NaN	NaN	0.1666667
Neg Pred Value	0.9809342	0.979376	0.9853566	0.98536	0.98725	0.992918	0.99339	0.992918	0.998111	0.9910038
Prevalence	0.0198300	0.021719	0.0146364	0.01464	0.01275	0.007082	0.00661	0.007082	0.001889	0.0094429
Detection Rate	0.0009443	0.001416	0.0000000	0.00000	0.00000	0.000000	0.00000	0.000000	0.000000	0.0004721
Detection Prevalence	0.0094429	0.015581	0.0004721	0.00000	0.00000	0.000000	0.00000	0.000000	0.000000	0.0028329
Balanced Accuracy	0.5194743	0.525369	0.4997604	0.50000	0.50000	0.500000	0.50000	0.500000	0.500000	0.5238084

SVM (STATE VECTOR MACHINES)

CLASS-WISE STATISTICS OF EACH KERNEL

2.POLYNOMIAL KERNEL

Statistics by Class:

	Class: 0	Class: 1	Class: 2	Class: 3	Class: 4	Class: 5	Class: 6	Class: 7	Class: 8	Class: 9	Class: 10	Class: 11
Sensitivity	0.5363	0.10900	0.30769	0.10132	0.0101523	0.0000000	0.00000	0.0000	0.00000	0.00000	0.0156250	0.00000
Specificity	0.7283	0.90299	0.59295	0.82866	0.9588756	0.9994893	1.00000	1.0000	1.00000	1.00000	0.9985394	1.00000
Pos Pred Value	0.2075	0.11058	0.10060	0.06628	0.0246914	0.0000000	NaN	NaN	NaN	NaN	0.2500000	NaN
Neg Pred Value	0.9221	0.90157	0.85269	0.88481	0.9042710	0.9244214	0.93579	0.9424	0.94901	0.96364	0.9701987	0.97639
Prevalence	0.1171	0.09962	0.12890	0.10718	0.0930123	0.0755430	0.06421	0.0576	0.05099	0.03636	0.0302172	0.02361
Detection Rate	0.0628	0.01086	0.03966	0.01086	0.0009443	0.0000000	0.00000	0.0000	0.00000	0.00000	0.0004721	0.00000
Detection Prevalence	0.3026	0.09821	0.39424	0.16383	0.0382436	0.0004721	0.00000	0.0000	0.00000	0.00000	0.0018886	0.00000
Balanced Accuracy	0.6323	0.50600	0.45032	0.46499	0.4845139	0.4997446	0.50000	0.5000	0.50000	0.50000	0.5070822	0.50000

	Class: 12	Class: 13	Class: 14	Class: 15	Class: 16	Class: 17	Class: 18	Class: 19	Class: 20	Class: 21
Sensitivity	0.00000	0.0000000	0.00000	0.00000	0.00000	0.000000	0.00000	0.000000	0.000000	0.000000
Specificity	1.00000	0.9995174	1.00000	1.00000	1.00000	1.000000	1.00000	1.000000	1.000000	1.000000
Pos Pred Value	NaN	0.0000000	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN
Neg Pred Value	0.98017	0.9782711	0.98536	0.98536	0.98725	0.992918	0.99339	0.992918	0.998111	0.990557
Prevalence	0.01983	0.0217186	0.01464	0.01464	0.01275	0.007082	0.00661	0.007082	0.001889	0.009443
Detection Rate	0.00000	0.0000000	0.00000	0.00000	0.00000	0.000000	0.00000	0.000000	0.000000	0.000000
Detection Prevalence	0.00000	0.0004721	0.00000	0.00000	0.00000	0.000000	0.00000	0.000000	0.000000	0.000000
Balanced Accuracy	0.50000	0.4997587	0.50000	0.50000	0.50000	0.500000	0.50000	0.500000	0.500000	0.500000

SVM (STATE VECTOR MACHINES)

CLASS-WISE STATISTICS OF EACH KERNEL

3.EUCLIDEAN KERNEL

Statistics by Class:

	class: 0	class: 1	class: 2	class: 3	class: 4	class: 5	class: 6	class: 7	class: 8	class: 9	class: 10	class: 11
Sensitivity	0.5363	0.11374	0.30769	0.10573	0.0101523	0.0000000	0.00000	0.0000	0.00000	0.00000	0.0156250	0.00000
Specificity	0.7283	0.90299	0.59566	0.82708	0.9588756	0.9994893	1.00000	1.0000	1.00000	1.00000	0.9985394	1.00000
Pos Pred Value	0.2075	0.11483	0.10120	0.06838	0.0246914	0.0000000	NaN	NaN	NaN	NaN	0.2500000	NaN
Neg Pred Value	0.9221	0.90204	0.85326	0.88512	0.9042710	0.9244214	0.93579	0.9424	0.94901	0.96364	0.9701987	0.97639
Prevalence	0.1171	0.09962	0.12890	0.10718	0.0930123	0.0755430	0.06421	0.0576	0.05099	0.03636	0.0302172	0.02361
Detection Rate	0.0628	0.01133	0.03966	0.01133	0.0009443	0.0000000	0.00000	0.0000	0.00000	0.00000	0.0004721	0.00000
Detection Prevalence	0.3026	0.09868	0.39188	0.16572	0.0382436	0.0004721	0.00000	0.0000	0.00000	0.00000	0.0018886	0.00000
Balanced Accuracy	0.6323	0.50837	0.45168	0.46640	0.4845139	0.4997446	0.50000	0.5000	0.50000	0.50000	0.5070822	0.50000

	class: 12	class: 13	class: 14	class: 15	class: 16	class: 17	class: 18	class: 19	class: 20	class: 21
Sensitivity	0.00000	0.0000000	0.00000	0.00000	0.00000	0.000000	0.00000	0.000000	0.000000	0.000000
Specificity	1.00000	0.9995174	1.00000	1.00000	1.00000	1.000000	1.00000	1.000000	1.000000	1.000000
Pos Pred Value	NaN	0.0000000	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN
Neg Pred Value	0.98017	0.9782711	0.98536	0.98536	0.98725	0.992918	0.99339	0.992918	0.998111	0.990557
Prevalence	0.01983	0.0217186	0.01464	0.01464	0.01275	0.007082	0.00661	0.007082	0.001889	0.009443
Detection Rate	0.00000	0.0000000	0.00000	0.00000	0.00000	0.000000	0.00000	0.000000	0.000000	0.000000
Detection Prevalence	0.00000	0.0004721	0.00000	0.00000	0.00000	0.000000	0.00000	0.000000	0.000000	0.000000
Balanced Accuracy	0.50000	0.4997587	0.50000	0.50000	0.50000	0.500000	0.50000	0.500000	0.500000	0.500000

SVM (STATE VECTOR MACHINES)

CLASS-WISE STATISTICS OF EACH KERNEL

4.HYPERBOLIC TANGENT KERNEL

Statistics by Class:

	Class: 0	Class: 1	Class: 2	Class: 3	Class: 4	Class: 5	Class: 6	Class: 7	Class: 8	Class: 9	Class: 10	Class: 11
Sensitivity	0.4637	0.11374	0.17582	0.10573	0.020305	0.0125000	0.000000	0.131148	0.083333	0.0259740	0.109375	0.0000000
Specificity	0.7171	0.91557	0.85962	0.90534	0.966163	0.9897855	0.985964	0.830160	0.951244	0.9857913	0.940117	0.9995164
Pos Pred Value	0.1786	0.12973	0.15635	0.11823	0.057971	0.0909091	0.000000	0.045070	0.084112	0.0645161	0.053846	0.0000000
Neg Pred Value	0.9098	0.90326	0.87576	0.89399	0.905808	0.9246183	0.935545	0.939875	0.950771	0.9640632	0.971328	0.9763817
Prevalence	0.1171	0.09962	0.12890	0.10718	0.093012	0.0755430	0.064212	0.057602	0.050992	0.0363551	0.030217	0.0236072
Detection Rate	0.0543	0.01133	0.02266	0.01133	0.001889	0.0009443	0.000000	0.007554	0.004249	0.0009443	0.003305	0.0000000
Detection Prevalence	0.3041	0.08735	0.14495	0.09585	0.032578	0.0103872	0.003777	0.167611	0.050519	0.0146364	0.061379	0.0004721
Balanced Accuracy	0.5904	0.51466	0.51772	0.50553	0.493234	0.5011427	0.497982	0.480654	0.517289	0.5058827	0.524746	0.4997582

	Class: 12	Class: 13	Class: 14	Class: 15	Class: 16	Class: 17	Class: 18	Class: 19	Class: 20	Class: 21
Sensitivity	0.00000	0.000000	0.000000	0.000000	0.00000	0.000000	0.00000	0.000000	0.000000	0.0500000
Specificity	0.99326	0.994208	0.998563	0.996646	1.00000	0.992392	1.00000	1.000000	1.000000	0.9985701
Pos Pred Value	0.00000	0.000000	0.000000	0.000000	NaN	0.000000	NaN	NaN	NaN	0.2500000
Neg Pred Value	0.98004	0.978158	0.985343	0.985315	0.98725	0.992864	0.99339	0.992918	0.998111	0.9910123
Prevalence	0.01983	0.021719	0.014636	0.014636	0.01275	0.007082	0.00661	0.007082	0.001889	0.0094429
Detection Rate	0.00000	0.000000	0.000000	0.000000	0.00000	0.000000	0.00000	0.000000	0.000000	0.0004721
Detection Prevalence	0.00661	0.005666	0.001416	0.003305	0.00000	0.007554	0.00000	0.000000	0.000000	0.0018886
Balanced Accuracy	0.49663	0.497104	0.499281	0.498323	0.50000	0.496196	0.50000	0.500000	0.500000	0.5242850

CLUSTERING

DATA PREPROCESSING

- *Environment setup to run R in a Python workspace*
- *Installation of 13 packages across data transformation, visualization and ML model building*
- *Loading dataset with required columns*

MODEL TRAINING & EVALUATION

- *Three selected clustering methods - PAM, Hierarchical and DBSCAN*
- *Usage of Gower distance for model building*

MODEL

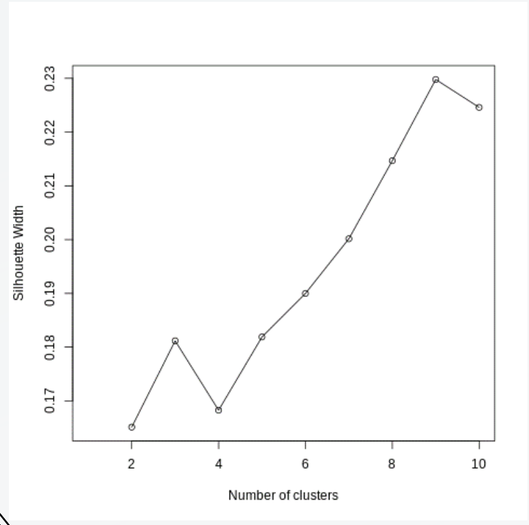
- *Below components are calculated for each clustering method -*

a. *Optimal no. of clusters*
b. *Elements per cluster*
c. *Structural plots*
d. *Interpretation of Clusters*

CLUSTERING

PAM CLUSTERING

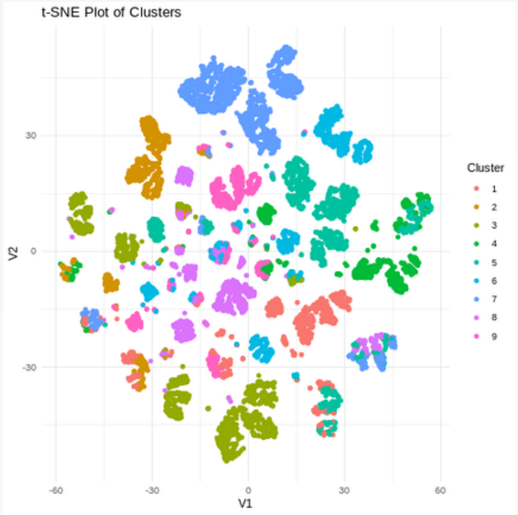
Optimal No. of Clusters



Elements per cluster

Cluster	Elements
1	1085
2	851
3	1501
4	888
5	1554
6	1093
7	1679
8	1084
9	856

Structural Plot



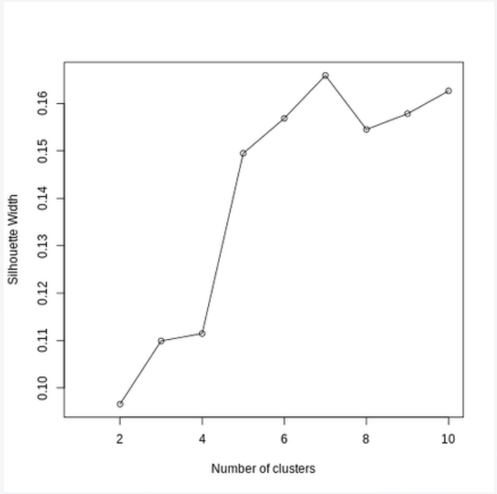
Interpretation of clusters

Cluster	GAD_T (Min-Max)	Narcissism (Min-Max)	SPIN_T (Min-Max)	Hours (Min-Max)	SWL_T (Min-Max)	Top whyplay_clean	Top Work Category	Top Playstyle_clean
1	0.0 - 21.0	1.0 - 5.0	0.0 - 62.0	0.0 - 100.0	5.0 - 35.0	fun (724)	Employed (1039)	Online w/ RL friends (776)
2	0.0 - 21.0	1.0 - 5.0	0.0 - 68.0	0.0 - 92.0	5.0 - 35.0	fun (813)	Students (573)	Online w/ strangers (828)
3	0.0 - 21.0	1.0 - 5.0	0.0 - 68.0	1.0 - 120.0	5.0 - 35.0	improving (1434)	Students (775)	Online w/ strangers (1454)
4	0.0 - 21.0	1.0 - 5.0	0.0 - 62.0	1.0 - 80.0	5.0 - 35.0	fun (563)	Students (871)	Online w/ RL friends (706)
5	0.0 - 21.0	1.0 - 5.0	0.0 - 64.0	2.0 - 105.0	5.0 - 35.0	improving (1394)	Students (1076)	Online w/ RL friends (1532)
6	0.0 - 21.0	1.0 - 5.0	0.0 - 67.0	2.0 - 120.0	5.0 - 35.0	improving (941)	Students (577)	Online w/ acquaintances (1021)
7	0.0 - 21.0	1.0 - 5.0	0.0 - 63.0	0.0 - 85.0	5.0 - 35.0	fun (1495)	Students (1583)	Online w/ RL friends (1639)
8	0.0 - 21.0	1.0 - 5.0	0.0 - 68.0	0.0 - 120.0	5.0 - 35.0	winning (1006)	Students (579)	Online w/ strangers (761)
9	0.0 - 21.0	1.0 - 5.0	0.0 - 67.0	1.0 - 100.0	5.0 - 35.0	fun (698)	Students (526)	Online w/ acquaintances (797)

CLUSTERING

HIERARCHICAL CLUSTERING

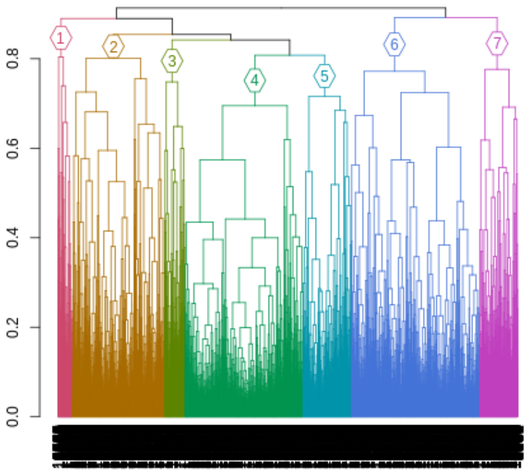
Optimal No. of Clusters



Elements per cluster

Cluster	Elements
1	2118
2	2950
3	874
4	2719
5	1121
6	474
7	335

Structural Plot



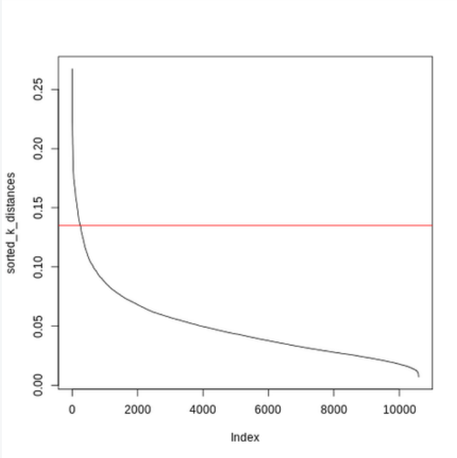
Interpretation of clusters

Cluster	GAD_T (Min-Max)	Narcissism (Min-Max)	SPIN_T (Min-Max)	Hours (Min-Max)	SWL_T (Min-Max)	Top whyplay_clean	Top Work Category	Top Playstyle_clean
1	0.0 - 21.0	1.0 - 5.0	0.0 - 64.0	0.0 - 120.0	5.0 - 35.0	fun (864)	Employed (1941)	Online w/ friends (881)
2	0.0 - 21.0	1.0 - 5.0	0.0 - 68.0	0.0 - 105.0	5.0 - 35.0	fun (936)	Students (2945)	Online w/ strangers (1537)
3	0.0 - 21.0	1.0 - 5.0	0.0 - 65.0	1.0 - 120.0	5.0 - 35.0	improving (431)	Unemployed (874)	Online w/ friends (321)
4	0.0 - 21.0	1.0 - 5.0	0.0 - 64.0	0.0 - 100.0	5.0 - 35.0	fun (1362)	Students (2296)	Online w/ friends (2719)
5	0.0 - 21.0	1.0 - 5.0	0.0 - 68.0	1.0 - 80.0	5.0 - 35.0	fun (650)	Students (1121)	Online w/ acquaintances (341)
6	0.0 - 21.0	1.0 - 5.0	0.0 - 62.0	1.0 - 100.0	5.0 - 35.0	fun (122)	Employed (75)	Singleplayer (321)
7	0.0 - 21.0	1.0 - 5.0	0.0 - 68.0	3.0 - 100.0	5.0 - 35.0	winning (275)	Students (103)	Online w/ strangers (287)

CLUSTERING

DBSCAN CLUSTERING

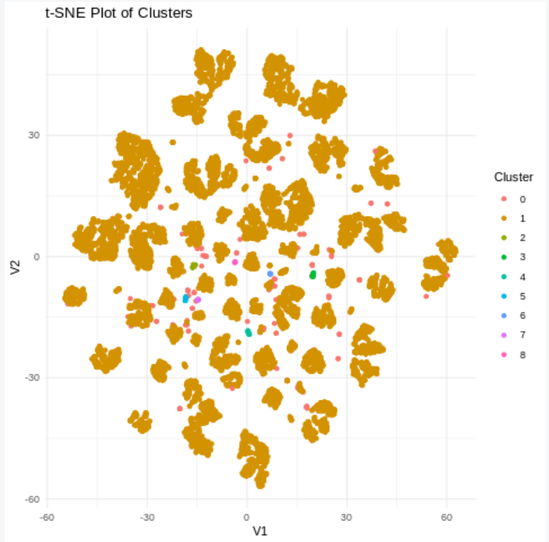
Optimal No. of Clusters



Elements per cluster

Cluster	Elements
0	116
1	10386
2	15
3	17
4	13
5	14
6	8
7	9
8	13

Structural Plot



Interpretation of clusters

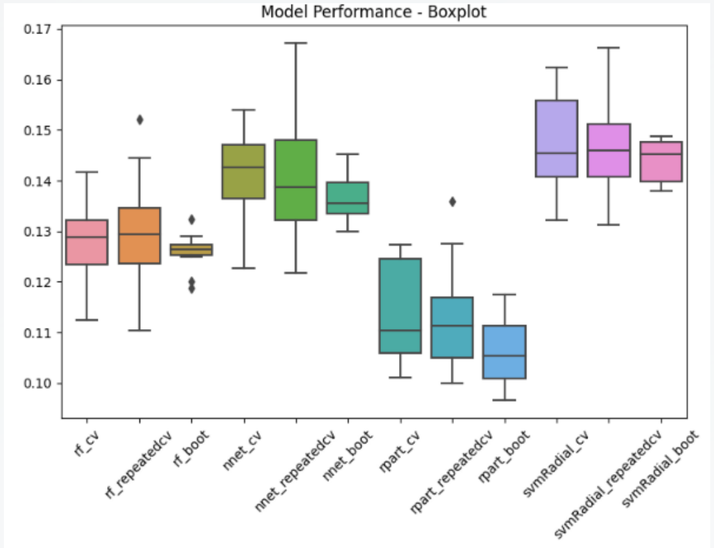
Cluster	GAD_T (Min-Max)	Narcissism (Min-Max)	SPIN_T (Min-Max)	Hours (Min-Max)	SWL_T (Min-Max)	Top whyplay_clean	Top Work Category	Top Playstyle_clean
0	0.0 - 21.0	1.0 - 5.0	0.0 - 68.0	2.0 - 120.0	5.0 - 35.0	relaxing (27)	Unemployed (43)	Online w/ acquaintances (22)
1	0.0 - 21.0	1.0 - 5.0	0.0 - 68.0	0.0 - 120.0	5.0 - 35.0	fun (4266)	Students (5654)	Online w/ RL friends (4797)
2	0.0 - 21.0	1.0 - 4.0	6.0 - 65.0	5.0 - 60.0	5.0 - 26.0	fun (15)	Unemployed (15)	Singleplayer (15)
3	0.0 - 17.0	1.0 - 4.0	7.0 - 44.0	8.0 - 35.0	10.0 - 32.0	relaxing (17)	Students (17)	Online w/ acquaintances (17)
4	0.0 - 14.0	1.0 - 4.0	2.0 - 35.0	6.0 - 87.0	9.0 - 31.0	winning (13)	Employed (13)	Singleplayer (13)
5	0.0 - 21.0	1.0 - 2.0	3.0 - 45.0	2.0 - 53.0	5.0 - 22.0	relaxing (14)	Unemployed (14)	Online w/ strangers (14)
6	0.0 - 16.0	1.0 - 3.0	7.0 - 30.0	1.0 - 20.0	10.0 - 27.0	relaxing (8)	Employed (7)	Singleplayer (8)
7	0.0 - 11.0	1.0 - 3.0	5.0 - 33.0	5.0 - 90.0	8.0 - 22.0	relaxing (9)	Unemployed (9)	Online w/ acquaintances (9)
8	2.0 - 11.0	1.0 - 3.0	0.0 - 44.0	3.0 - 35.0	10.0 - 21.0	relaxing (13)	Students (13)	Singleplayer (13)

COMPARATIVE ANALYSIS

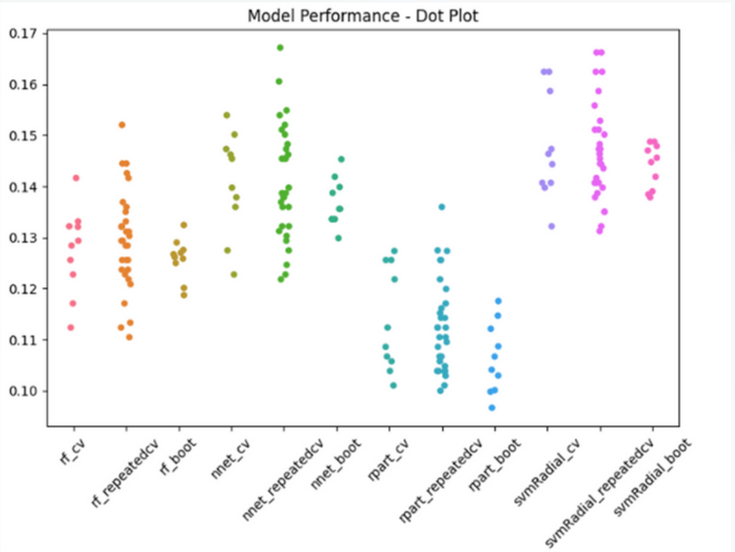
Statistical summary

Metric	Best Model Performance	Worst Model Performance
Mean	SVM (Standard K-Fold): 14.75%	Decision Tree (Bootstrapping): 10.64%
Standard Deviation	Random Forest (Bootstrapping): 0.40%	Neural Network (Repeated K-Fold): 1.12%
Minimum	Random Forest (Bootstrapping): 11.87%	Decision Tree (Bootstrapping): 9.67%
25th Percentile	Random Forest (Bootstrapping): 12.52%	Decision Tree (Bootstrapping): 10.08%
Median (50%)	SVM (Standard K-Fold): 14.54%	Decision Tree (Bootstrapping): 10.54%
75th Percentile	SVM (Repeated K-Fold): 15.11%	Decision Tree (Standard K-Fold): 12.46%
Maximum	Neural Network (Repeated K-Fold): 16.71%	Decision Tree (Bootstrapping): 11.76%

Box Plot



Dot Plot



ETHICAL ISSUES

Overview of Dataset

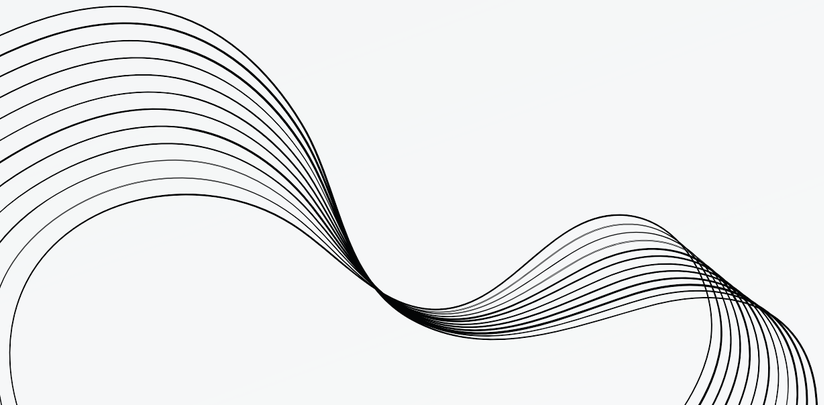
- *2017 Survey with 13,000 participants*
- *To focus on links between gaming habits, socio-economic factors, and psychological measures*

Significance

- *Largest dataset of its kind*
- *Openly accessible*

Procedure to address ethical issues

- *Methodology -*
  a. *How was the data gathered?*
  b. *Were the participants informed and consented?*
- *Initial Data Processing -*
  a. *How was the data anonymized or de-identified?*
  b. *Measures to protect participant privacy*



ETHICAL ISSUES

PROCEDURE

Data Collection Method

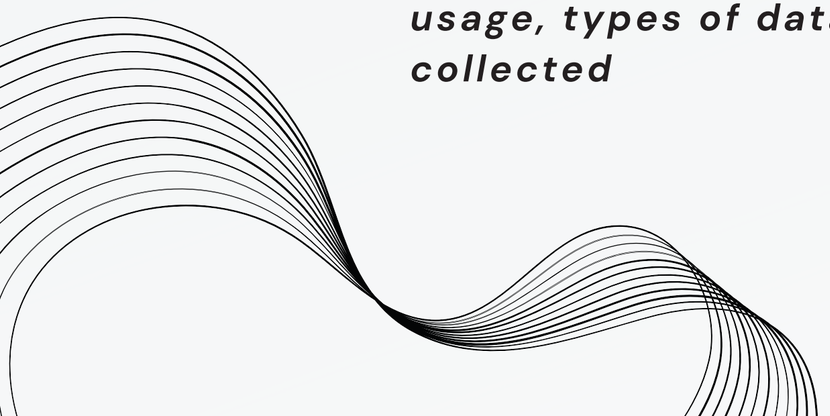
- *Platforms used were Reddit, CrowdFlower, TeamLiquid.net*
- *Target Group was Video game players*
- *Information was provided about data usage, types of data collected*

Ethical Considerations

- *Consent was taken from participants to ensure awareness*
- *Freedom was given to withdraw anytime without consequences*
- *No direct PII collected to maintain confidentiality*

Data Diversity

- *Participants from 109 countries; majority from the USA, Germany, the UK, Canada*
- *Gender Imbalance exists with 12699 male, 713 female, 52 other*



ETHICAL ISSUES

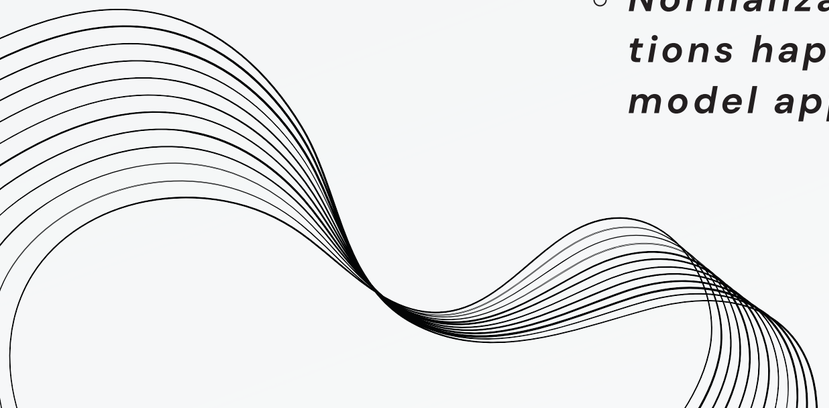
PROCEDURE

Data Processing and Cleaning

- *Survey responses in CSV format*
- *Outliers were removed, irrelevant columns were removed, useful categorical columns were cleaned*
- *Normalization/standardizations happened during model applications*

Data Diversity

- *Aggregation and Segmentation happened on country, age etc. for meaningful analysis*
- *Systematic categorization of open-ended responses for research objective*



NEURAL NETWORKS

DATA PREPARATION

BEFORE NORMALIZATION

Before Normalization:

	Age	GAD_T	Hours	Narcissism	SPIN_T	SWL_T
count	10591.000000	10591.00000	10591.000000	10591.000000	10591.000000	10591.000000
mean	20.828911	5.17411	21.360023	2.021433	19.730998	19.838825
std	3.154145	4.66851	13.257550	1.057378	13.368407	7.181354
min	18.000000	0.00000	0.000000	1.000000	0.000000	5.000000
25%	18.000000	2.00000	12.000000	1.000000	9.000000	14.000000
50%	20.000000	4.00000	20.000000	2.000000	17.000000	20.000000
75%	22.000000	8.00000	28.000000	3.000000	28.000000	26.000000
max	56.000000	21.00000	120.000000	5.000000	68.000000	35.000000

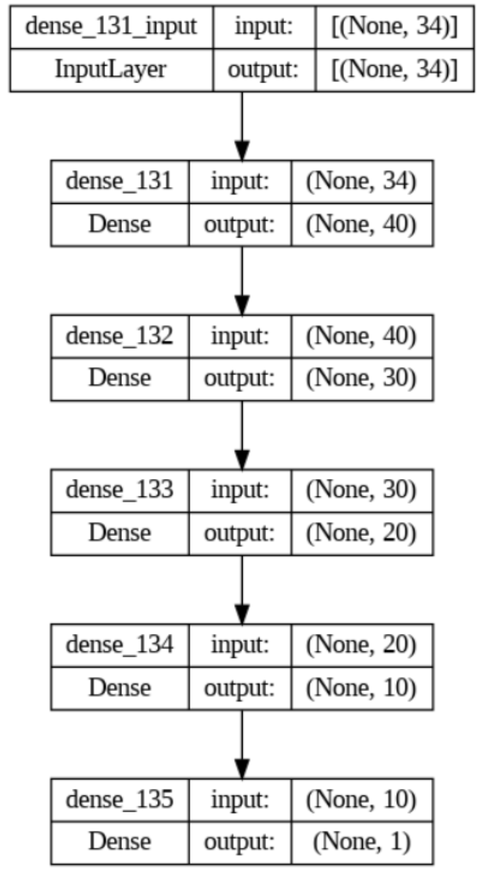
AFTER NORMALIZATION

After Normalization:

	GAD_T	Hours	SPIN_T	SWL_T	whyplay_clean_all	whyplay_clean_distraction	whyplay_clean_fun
count	10591.000000	10591.000000	10591.000000	10591.000000	10591.000000	10591.000000	10591.000000
mean	0.246386	0.178000	0.290162	0.494628	0.007365	0.002644	0.405344
std	0.222310	0.110480	0.196594	0.239378	0.085506	0.051352	0.490982
min	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
25%	0.095238	0.100000	0.132353	0.300000	0.000000	0.000000	0.000000
50%	0.190476	0.166667	0.250000	0.500000	0.000000	0.000000	0.000000
75%	0.380952	0.233333	0.411765	0.700000	0.000000	0.000000	1.000000
max	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000

NEURAL NETWORKS

NEURAL NETWORK ARCHITECTURE DIAGRAM



LAYER CONFIGURATIONS AND ACTIVATIONS

```
layer_configs = [(10,)- One hidden layer with 10 nodes,
                 (20,)- One hidden layer with 20 nodes,
                 (10, 10)- Two hidden layers with 10 nodes each,
                 (20, 10)- Two hidden layers with 20 nodes in the first and 10 in the second,
                 (20, 20)- Two hidden layers with 20 nodes in each,
                 (30, 20, 10)- Three hidden layers with 30, 20, and 10 nodes in each
          respective layer,
                 (40, 30, 20, 10)] - Four hidden layers with 40, 30, 20, and 10 in
          each respective layer.


activations = ['relu', 'sigmoid']
```

NEURAL NETWORKS

RESULTS AND MODEL DETAILS

```
results_reg_nn
```

```
{((10,),
  'relu'): {'loss': [0.06763207912445068,
   0.041859984397888184,
   0.03746723756194115,
   0.036340437829494476,
   0.0357864573597908,
   0.035379815846681595,
   0.035160861909389496,
   0.03506303206086159,
   0.0349060520529747,
   0.03486179932951927,
   0.034709978848695755,
   0.034604039043188095,
   0.0345996618270874,
   0.034503109753131866,
   0.03446292504668236,
   0.03434351459145546,
   0.03439820557832718,
   0.03435637801885605,
   0.03432324528694153,
   0.03415769338607788,
   0.034300852566957474,
   0.034225933253765106,
   0.03406434878706932,
   0.034058745950460434,
   0.034002020955085754,
   0.03400377184152603,
   0.03401808813214302,
   0.03397216647863388,
   0.03400079160928726,
   0.03396153822541237,
   0.03390432149171829,
```

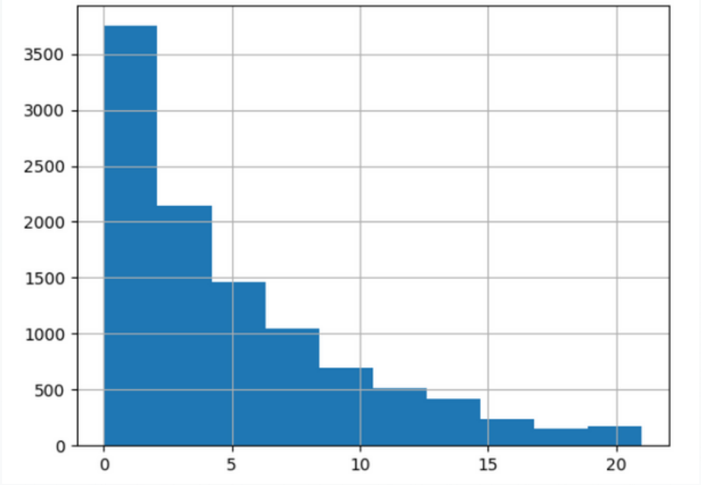
- *EPOCHS: 100*
- *Learning Rate: 0.01*
- *With every single run of the entire dataset, for each epoch, the loss is reducing as we can see from the screenshot.*
- *We stored all the results in a dictionary.*
- *Sorted the results and printed out the best configuration with the highest mae.*

```
Top 5 Configurations:
Rank 1: Configuration ((30, 20, 10), 'sigmoid'), Best Validation Accuracy: 0.1793
Rank 2: Configuration ((10,), 'relu'), Best Validation Accuracy: 0.1781
Rank 3: Configuration ((10,), 'sigmoid'), Best Validation Accuracy: 0.1759
Rank 4: Configuration ((40, 30, 20, 10), 'sigmoid'), Best Validation Accuracy: 0.1744
Rank 5: Configuration ((10, 10), 'sigmoid'), Best Validation Accuracy: 0.1743
```

THE HISTOGRAM SHOWS HOW OUR DATA IS HIGHLY SKEWED FOR DIFFERENT CLASSES:

```
anxiety['GAD_T'].hist()
```

```
<Axes: >
```



NEURAL NETWORKS

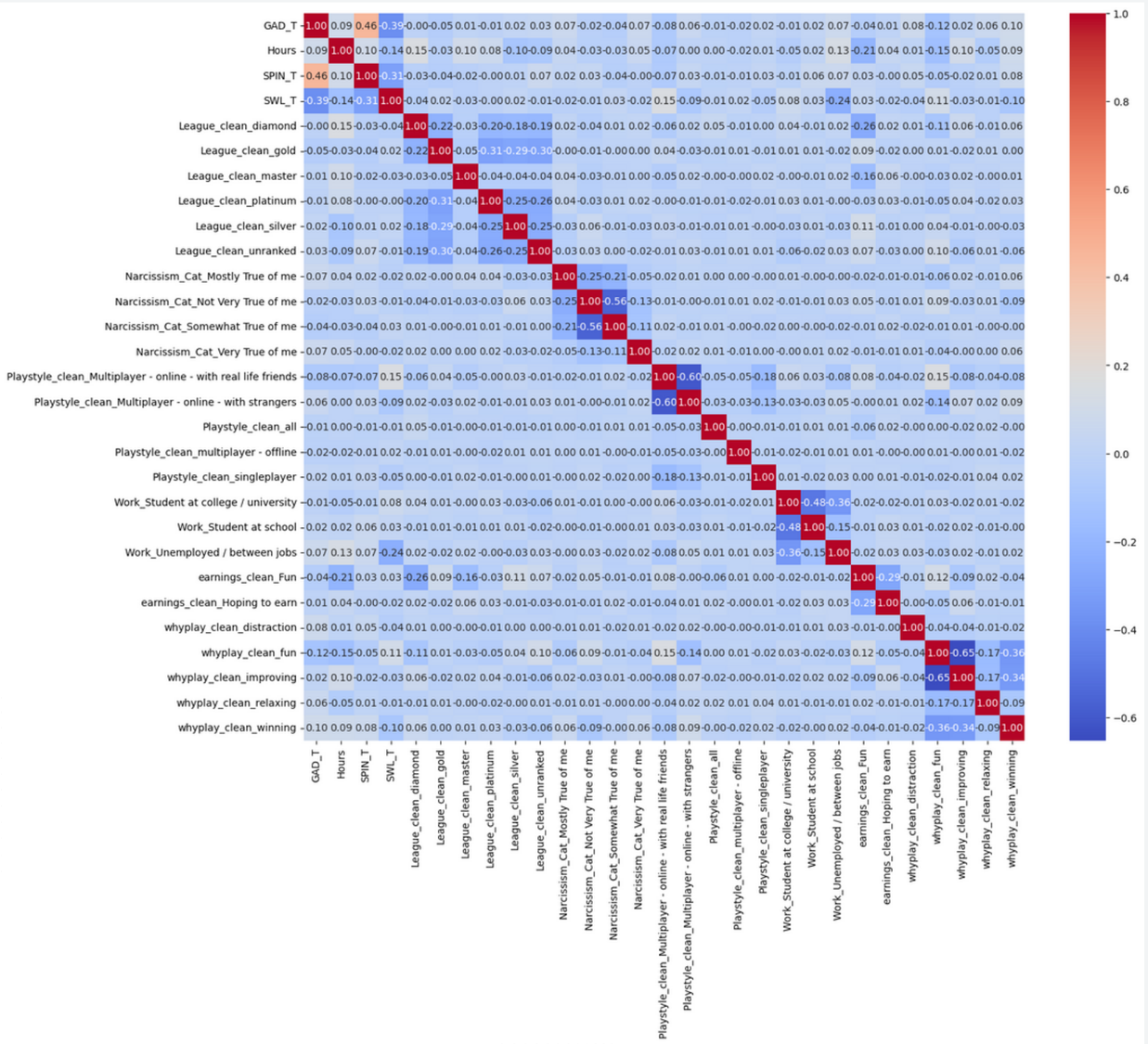
CLASSIFICATION NEURAL NETWORK MODEL

- *CATEGORIZED GAD_T TO 2 CATEGORIES, 0(NO ANXIETY) AND 1 (HAS ANXIETY)*
- *RAN THE CLASSIFICATION MODEL:*

```
Best Configuration: ((40, 30, 20, 10), 'logistic')
Best Accuracy: 0.8716375648890986
Best Correlation: 0.5325210659339328
Confusion Matrix:
[[1767   38]
 [ 234   80]]
```

FEATURE SELECTION

FILTERS WITH SVM



<- CORRELATION MATRIX

WITH ALL FEATURES:

```
Mean Squared Error: 16.06
Root Mean Squared Error: 4.01
```

AFTER REMOVING CLASS PLAYSTYLE:

```
Mean Squared Error: 16.05
Root Mean Squared Error: 4.01
```

FEATURE SELECTION

EMBEDDED: REGULARIZATION(L1) FOR NEURAL NETWORKS

- *L1 REGULARIZATION WITH NEURAL NETWORK FOR FEATURE SELECTION:*
- *EPOCHS: 100*
- *Learning Rate: 0.01*
- *We stored all the results in a dictionary.*
- *Sorted the results and printed out the best configuration with the highest mae.*

OUR NEURAL NETWORK RESULTS:

```
Top 5 Configurations:
Rank 1: Configuration ((30, 20, 10), 'sigmoid'), Best Validation Accuracy: 0.1793
Rank 2: Configuration ((10,), 'relu'), Best Validation Accuracy: 0.1781
Rank 3: Configuration ((10,), 'sigmoid'), Best Validation Accuracy: 0.1759
Rank 4: Configuration ((40, 30, 20, 10), 'sigmoid'), Best Validation Accuracy: 0.1744
Rank 5: Configuration ((10, 10), 'sigmoid'), Best Validation Accuracy: 0.1743
```

WITH REGULARIZATION:

```
Top 5 Configurations:
Rank 1: Configuration ((10,), 'sigmoid'), Best Validation Accuracy: 0.1928
Rank 2: Configuration ((20, 20), 'sigmoid'), Best Validation Accuracy: 0.1874
Rank 3: Configuration ((20,), 'sigmoid'), Best Validation Accuracy: 0.1849
Rank 4: Configuration ((20, 20), 'relu'), Best Validation Accuracy: 0.1847
Rank 5: Configuration ((30, 20, 10), 'sigmoid'), Best Validation Accuracy: 0.1842
```

FEATURE SELECTION

WRAPPER: SFS WITH LINEAR REGRESSION

SHORTLISTED VARS:

```
> print(shortlistedVars)
 [1] "(Intercept)"                          "SPIN_T"
 [3] "SWL_T"                                "whyplay_cleandistraction"
 [5] "whyplay_cleanfun"                     "whyplay_cleanimproving"
 [7] "whyplay_cleanrelaxing"                "whyplay_cleanwinning"
 [9] "Narcissism_CatMostly True of me"      "Narcissism_CatNot Very True of me"
[11] "Narcissism_CatSomewhat True of me"    "Narcissism_CatVery True of me"
[13] "League_cleandiamond"                  "League_cleangold"
[15] "League_cleanmaster"                   "League_cleanplatinum"
[17] "League_cleansilver"                   "League_cleanunranked"
[19] "earnings_cleanFun"                    "earnings_cleanHoping to earn"
[21] "WorkStudent at college / university" "WorkStudent at school"
[23] "WorkUnemployed / between jobs"        "Hours"
```

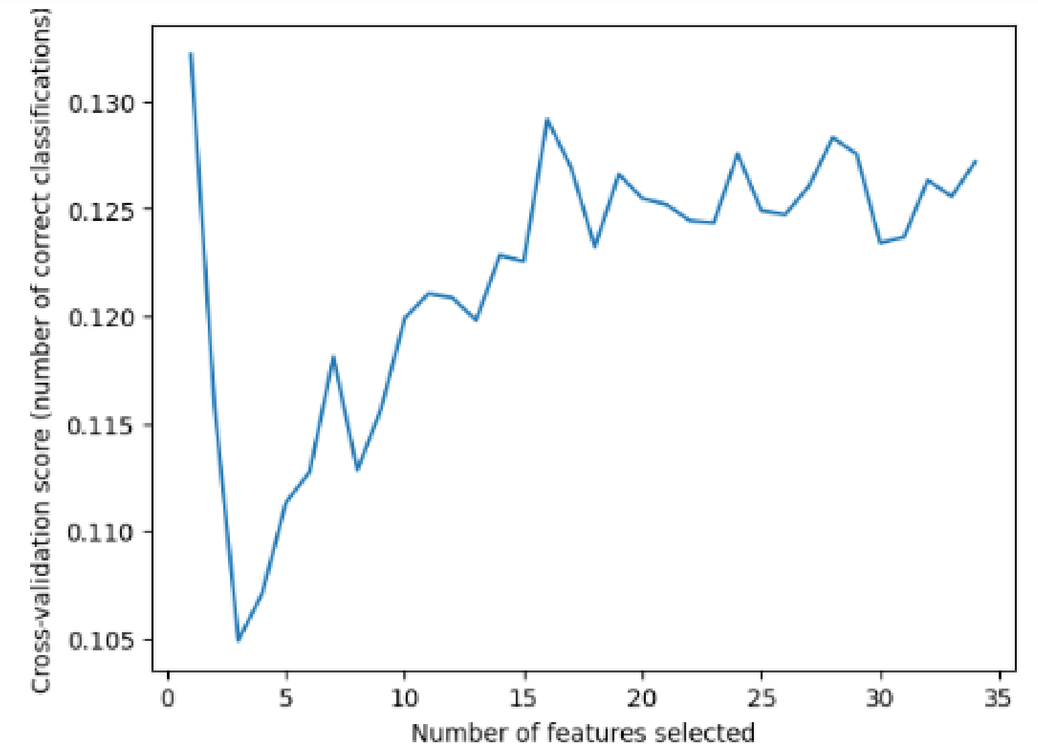
MODEL SUMMARY:

```
lm(formula = GAD_T ~ SPIN_T + SWL_T + whyplay_clean + Narcissism_Cat +
    League_clean + earnings_clean + Work + Hours, data = dataforSFS)

Residuals:
     Min       1Q   Median       3Q      Max
-11.3310  -2.6256  -0.6518   1.8955  20.5710

Coefficients:
                                           Estimate Std. Error t value Pr(>|t|)
(Intercept)                                9.863388   1.402301   7.034 2.14e-12 ***
SPIN_T                                     0.125444   0.003043  41.224  < 2e-16 ***
SWL_T                                     -0.176996   0.005790 -30.572  < 2e-16 ***
whyplay_cleandistraction                   3.731554   0.865384   4.312 1.63e-05 ***
whyplay_cleanfun                          -0.710103   0.448490  -1.583  0.11338
whyplay_cleanimproving                    -0.304068   0.448629  -0.678  0.49793
whyplay_cleanrelaxing                      0.642749   0.481473   1.335  0.18192
whyplay_cleanwinning                       0.043807   0.454999   0.096  0.92330
Narcissism_CatMostly True of me            0.666192   0.159269   4.183 2.90e-05 ***
Narcissism_CatNot Very True of me         -0.264509   0.111332  -2.376  0.01753 *
Narcissism_CatSomewhat True of me         -0.192584   0.114002  -1.689  0.09119 .
Narcissism_CatVery True of me              1.746655   0.266548   6.553 5.91e-11 ***
League_cleandiamond                       -3.245781   1.313055  -2.472  0.01345 *
League_cleangold                          -2.995952   1.309847  -2.287  0.02220 *
League_cleanmaster                        -2.845912   1.379940  -2.062  0.03920 *
League_cleanplatinum                      -2.955779   1.310444  -2.256  0.02412 *
League_cleansilver                        -2.490981   1.310401  -1.901  0.05734 .
League_cleanunranked                      -2.680360   1.310277  -2.046  0.04082 *
earnings_cleanFun                         -0.703626   0.150867  -4.664 3.14e-06 ***
earnings_cleanHoping to earn              -0.494799   0.443069  -1.117  0.26413
WorkStudent at college / university        0.275380   0.100839   2.731  0.00633 **
WorkStudent at school                      0.173412   0.127854   1.356  0.17502
WorkUnemployed / between jobs             -0.035553   0.153667  -0.231  0.81704
Hours                                      0.004823   0.003056   1.578  0.11454
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 3.92 on 10567 degrees of freedom
Multiple R-squared:  0.2965,    Adjusted R-squared:  0.2949
F-statistic: 193.6 on 23 and 10567 DF,  p-value: < 2.2e-16
```

FEATURE SELECTION

HYBRID: RFE WITH RANDOM FORESTS

RFECV
estimator: RandomForestClassifier
RandomForestClassifier




```
Optimal number of features : 1
Index(['SPIN_T'], dtype='object')
```

THANK YOU