

# Efficient Multi-class Anxiety Level Prediction Approximation for Long Assessments

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## BACKGROUND

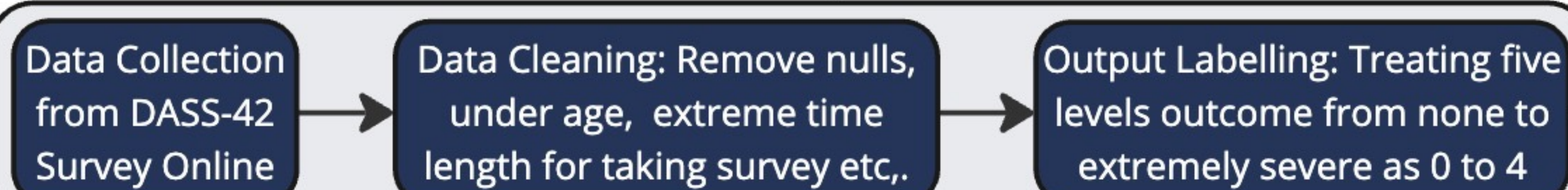
- Anxiety disorders** have been a significant public health concern and can affect one's quality of life and impair daily functioning. Affecting **264 million** people worldwide, **60%** of college students in US reported having overwhelming anxiety in the past year.
- Psychometric assessments such as Depression Anxiety Stress Scale (DASS) are effective but flawed in design, leading to fewer respondents and lower response quality.
- Q: Can we use machine learning techniques to predict our anxiety level accurately and efficiently based on existing assessments?

## DATA SOURCE

- Derived from DASS-42 Scale, which was completed by a large and diverse sample of participants (N=31,715), collected from an online website called *Open Psychometrics*.
- 42 items are scored on a 4-point likert scale ranging from none to always, indicating level of symptoms experienced over past week.
- The resulting level of anxiety is calculated by summing up scores of relevant questions.
- Resulting anxiety labels are classified into 5 levels of severity: Normal, Mild, Moderate, Severe, Extremely Severe

## METHODS

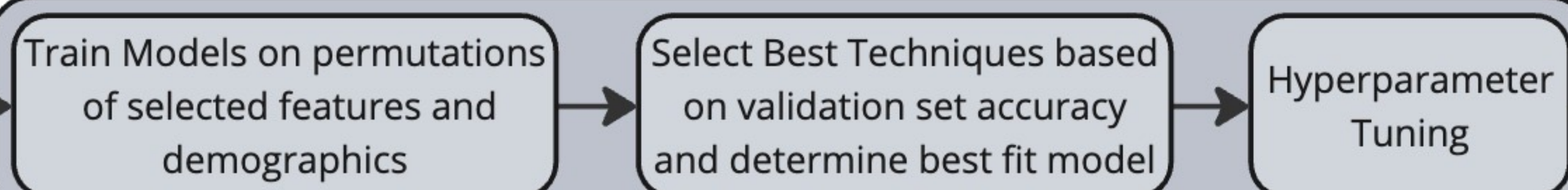
### Dataset Preparation



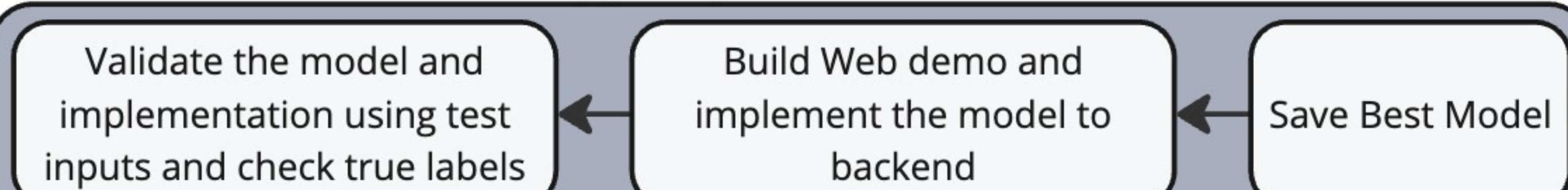
### Dataset Processing



### Machine Learning



### App Implementation



## RESULTS

- Models Explored and have hyperparameter tuned:
  - K-Nearest Neighbors (KNN)
  - Support Vector Machine (SVM)
  - Multi-Layer Perceptron (MLP)
  - Kolmogorov–Arnold Networks (KAN)
  - Stacked Generalization Ensemble (Ensemble)
- Ensemble model achieved highest accuracy in both cases with and without demographics.
- 7 items with demographic features or 9 items without to reach 85% accuracy in five-level multiclass classification task.

- E.g., SHAP Selected Items:
  - [#28] I felt I was close to panic.
  - [#20] I felt scared without any good reason.
  - [#41] I experienced trembling (eg, in the hands)
- Implementing Ensemble Model:
  - Hyperparameter tuned over combinations of 7 questions input
  - Validation AUC Score of 86.85%
  - F1 Score of 78.96%
  - Cohen's Kappa ( $\kappa$ ) of 73.67%

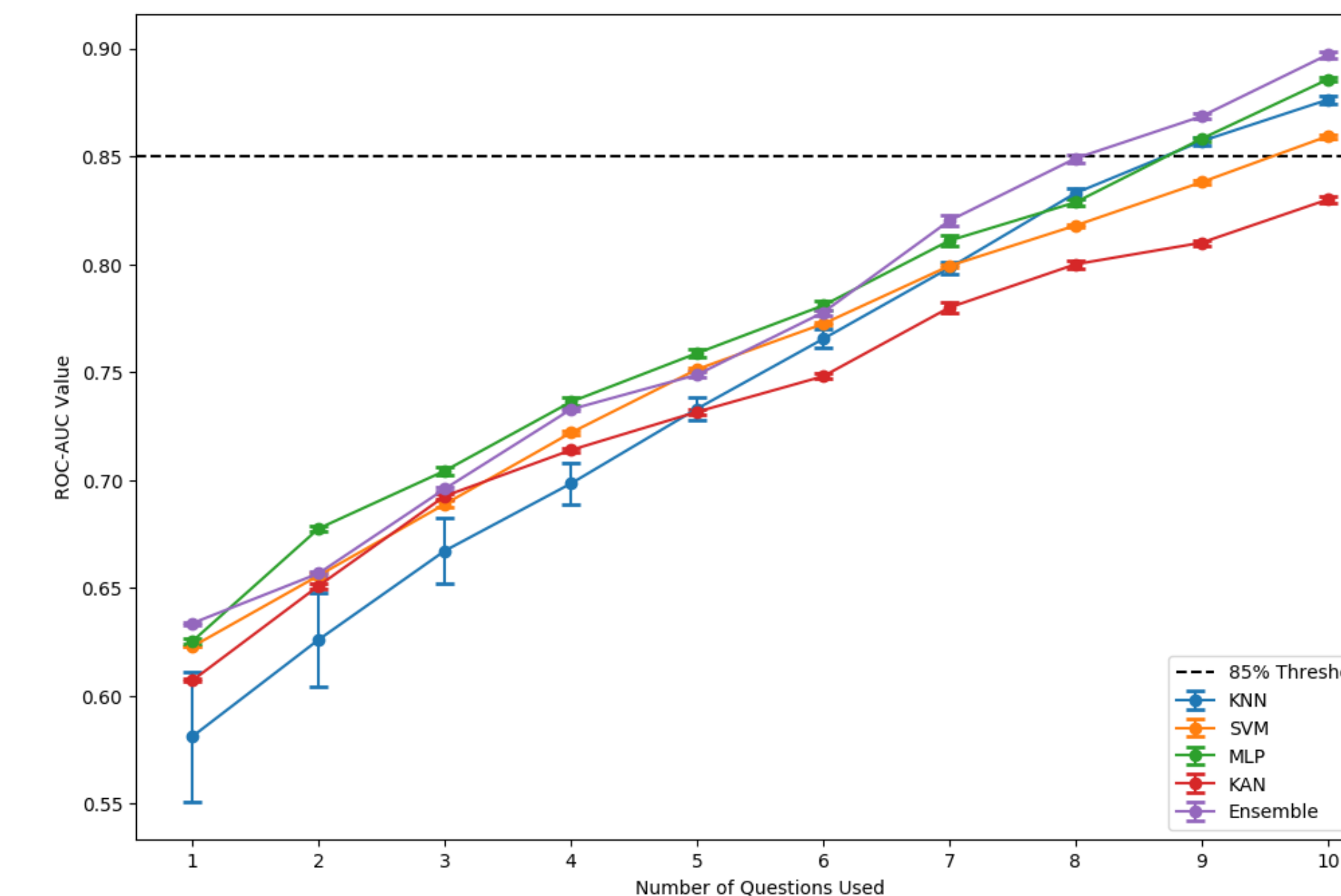


Figure 1: Models Performances over Number of Questions Trained without Demographics. Note that the Base line accuracy in a 5-class prediction task is 20%.

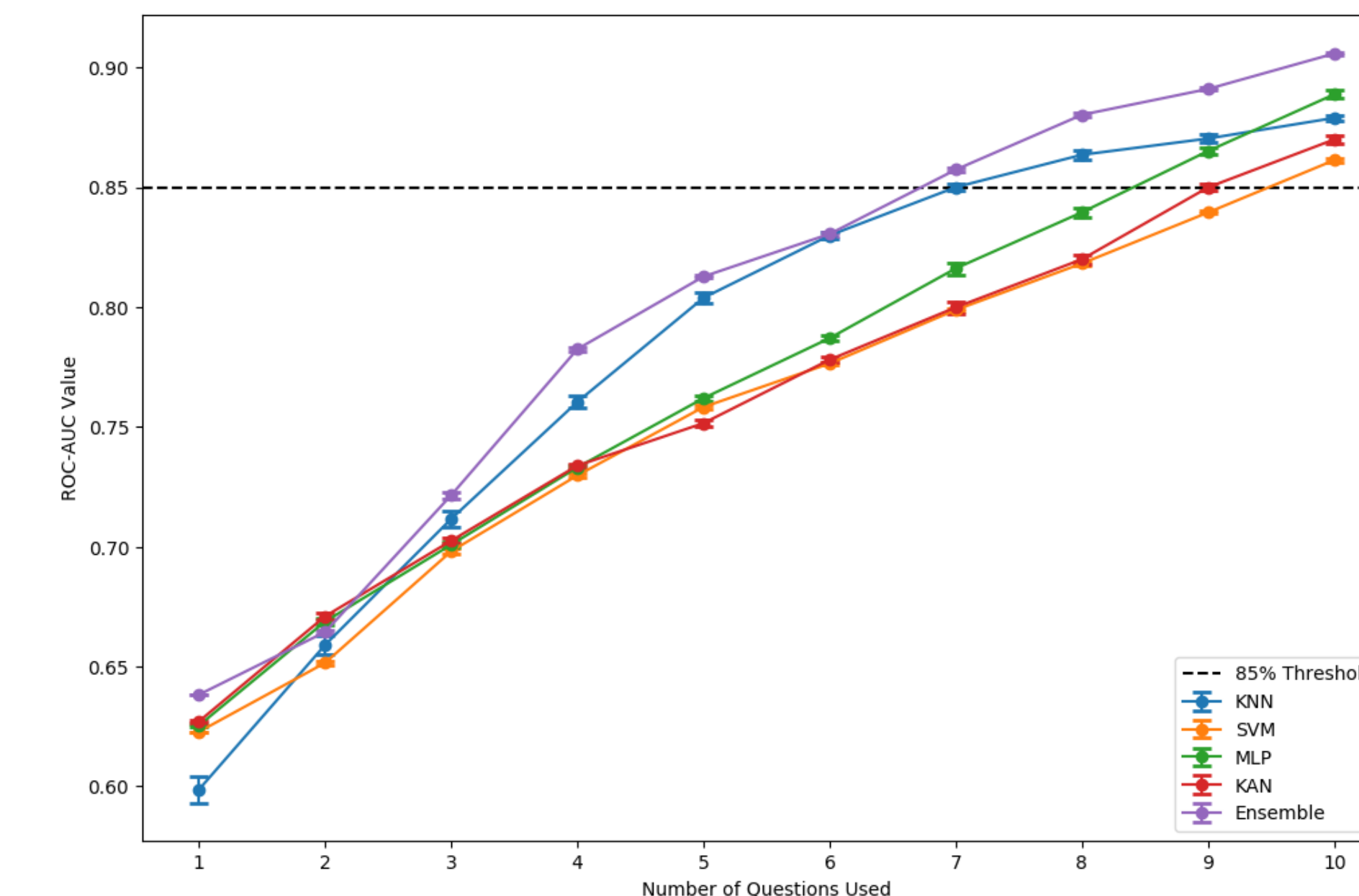


Figure 2: Models Performances over Number of Questions Trained with Demographics. Note that the Base line accuracy in a 5-class prediction task is 20%.

## APPLICATION

Welcome to the Depression Anxiety Stress Scales (DASS) prediction interactive webpage.

This applet computes an individual's anxiety severity in five levels using a machine learning model trained using data collected from an online survey.

Progress

0/9

I experienced breathing difficulty (e.g., excessively rapid breathing, breathlessness in the absence of physical exertion).

Click to drop down

I had a feeling of shakiness (e.g., legs going to give way).

Click to drop down

I found myself in situations that made me so anxious I was most relieved when they ended.

✓ Click to drop down

Did not apply to me at all

Applied to me to some degree, or some of the time

Applied to me to a considerable degree, or a good part of time

Applied to me very much, or most of the time

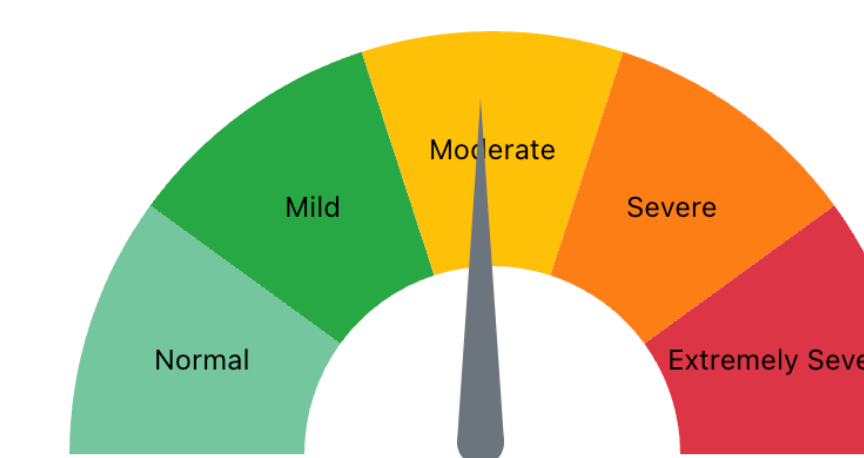
I was aware of the action of my heart in the absence of physical exertion (e.g., sense of heart rate increase, heart missing a beat).

Click to drop down

Welcome to the results page for the Depression Anxiety Stress Scales (DASS) multiclass prediction interactive webpage survey.

**Your predicted anxiety severity level is: moderate.**

Displayed is your estimated anxiety severity level given your answers to the selected DASS questions. This is calculated through a machine learning model pre-trained using data collected from an online survey.



\*This webpage does not contain medical/health advice. This tool is intended for informational and educational purposes only, and should not be taken as a substitute for professional advice. Reliance on any information on the webpage is solely at your own risk.

Scan the QR Code to test out the assessment:



More about me and my research, feel free to reach out:



## DISCUSSION

- Key features relevant to predicting anxiety levels are identified and applied for training ML model.
- Time and effort needed for assessing anxiety status are significantly reduced while maintaining high prediction accuracy and reliability.
- Web App with our model in the backend can be used for regularly self-screening or clinical assessment.
- Wide applications to other forms of mental health assessments to significantly reduce the efforts needed.

## ACKNOWLEDGEMENT

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