

Features extraction and outcome prediction for fairness evaluation: the case study of asylum request

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Introduction: The Dataset

Scope

91 fully annotated asylum applications.

Complexity

313 questions extracted per application, validated by human experts.

Challenge

High volume of open-ended questions requiring advanced encoding strategies.

Methodology: 4-Stage Encoding Process

O1

LLM Generation

Gemini 2.0 Flash proposed 3-7 categories per answer for all 313 questions.

O3

Application

LLM assigned the validated categories to individual answers, producing detailed JSON outputs.

O2

Expert Validation

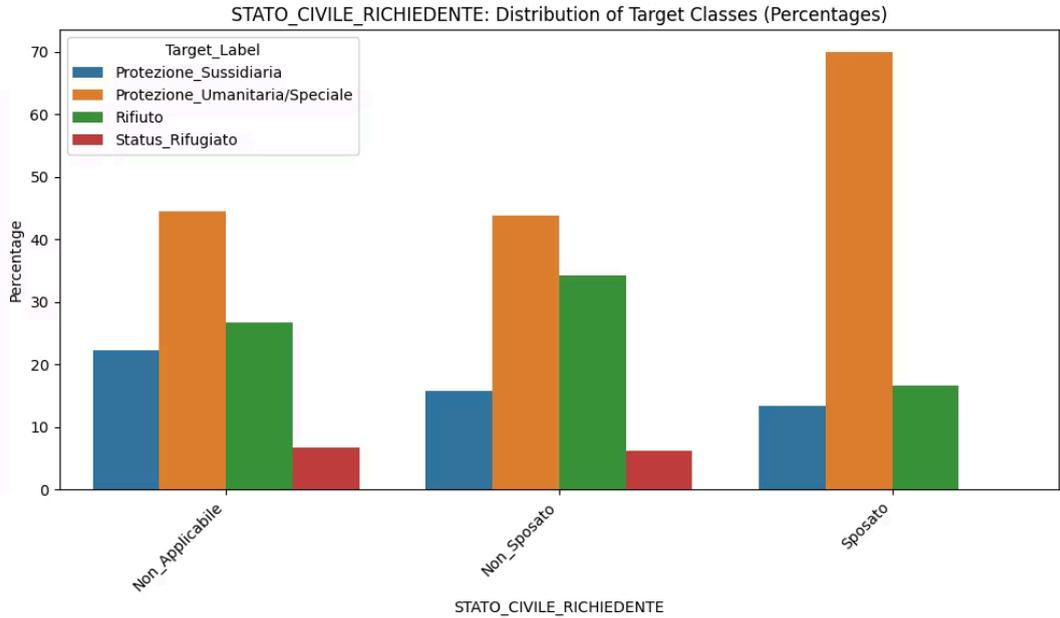
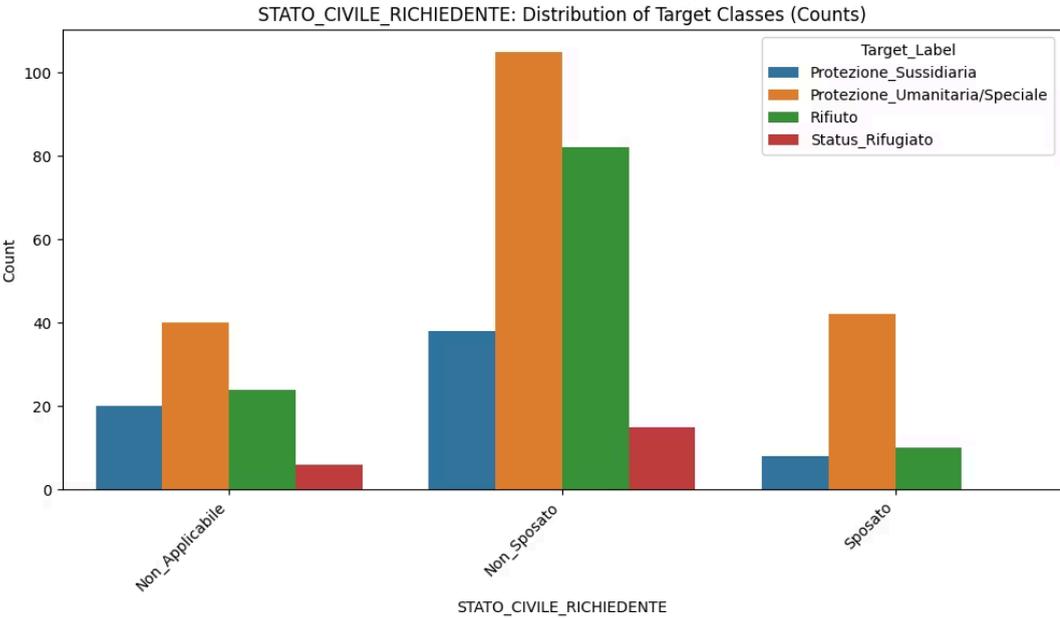
Two legal experts reviewed and refined categories to ensure they were non-overlapping and legally sound.

O4

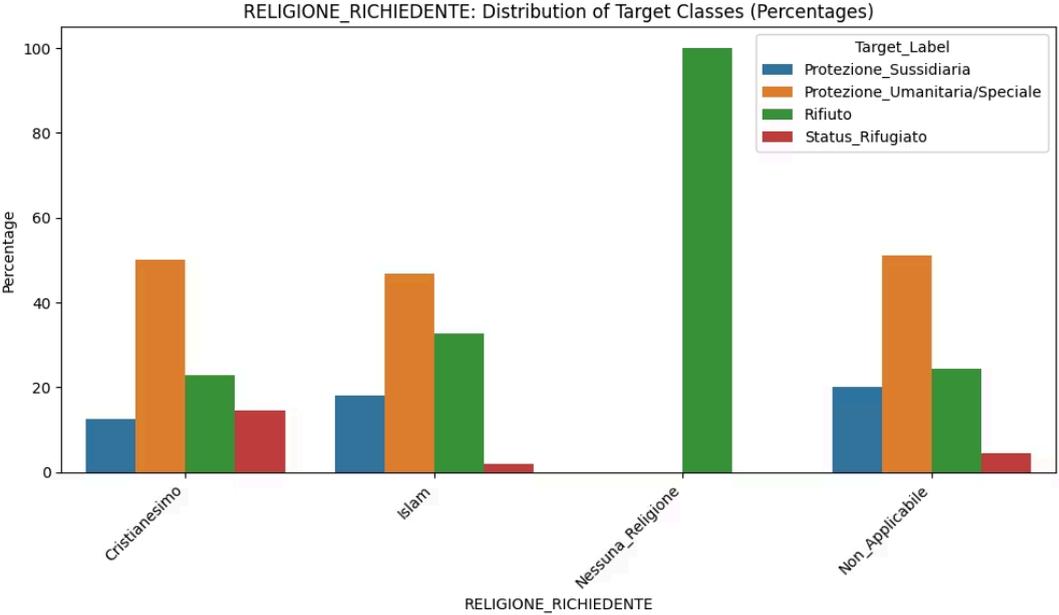
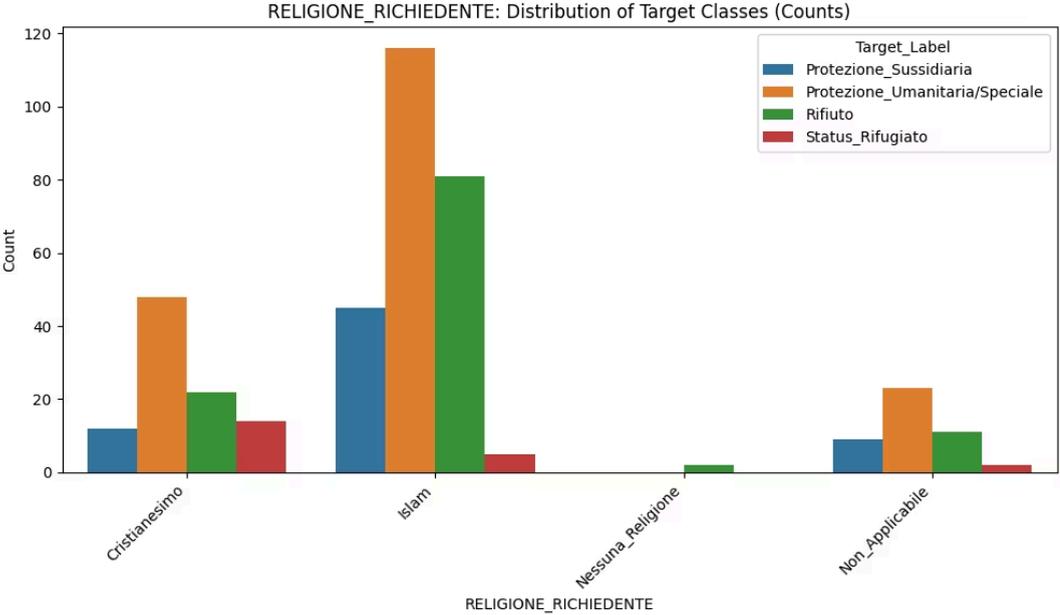
Feature Encoding

Categories converted to numerical features using LabelEncoder (ordinal encoding) to prepare for machine learning.

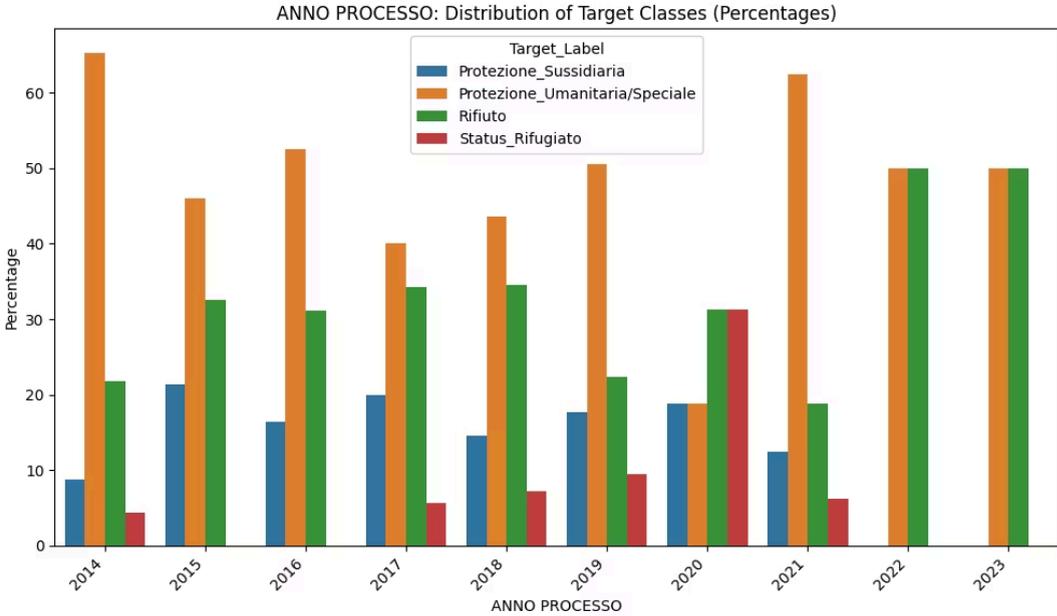
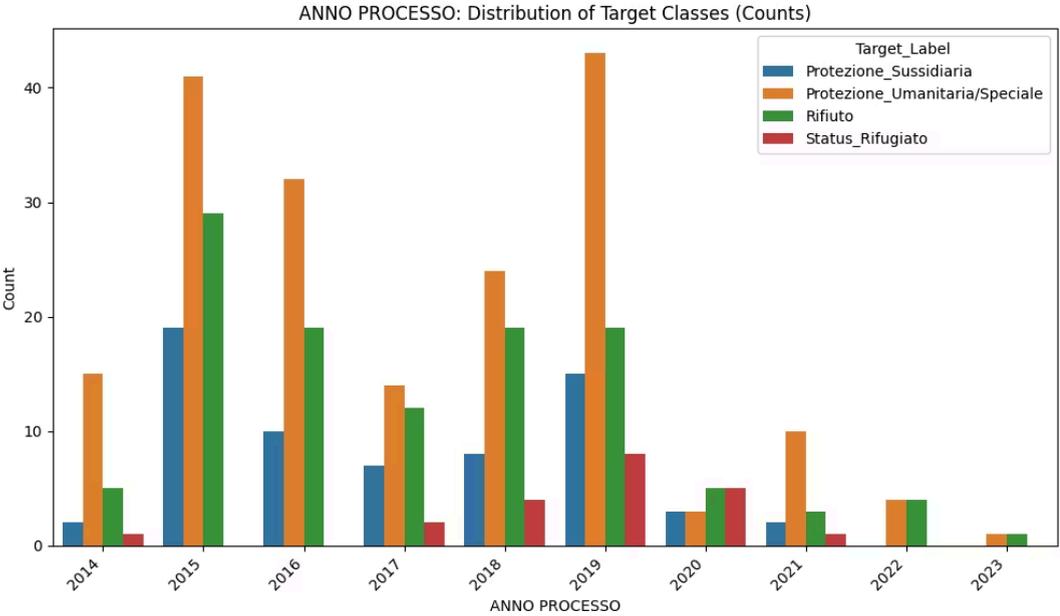
Case Distribution: Marital Status



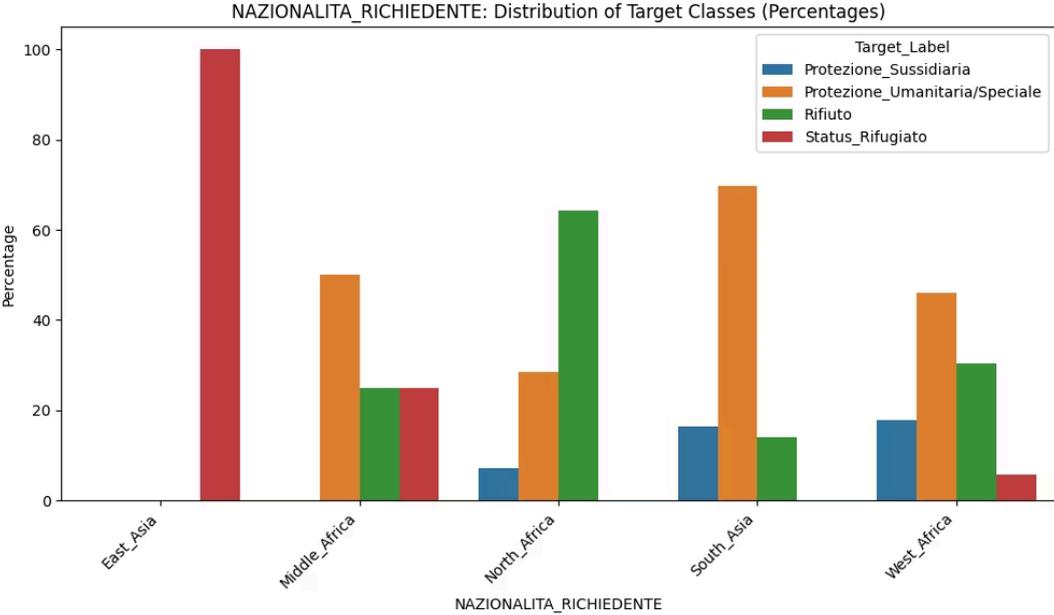
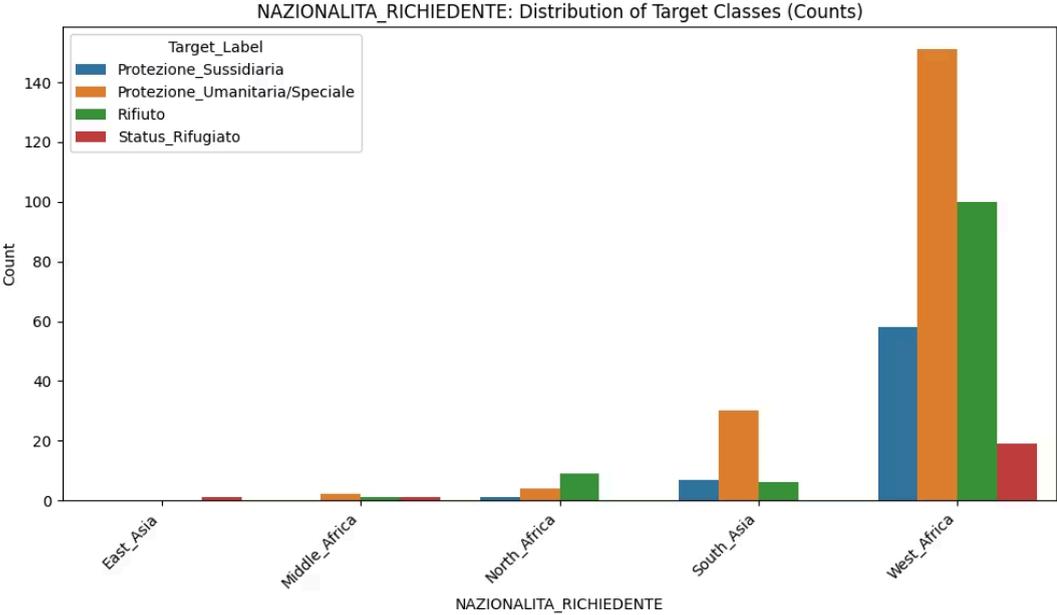
Case Distribution: Religion



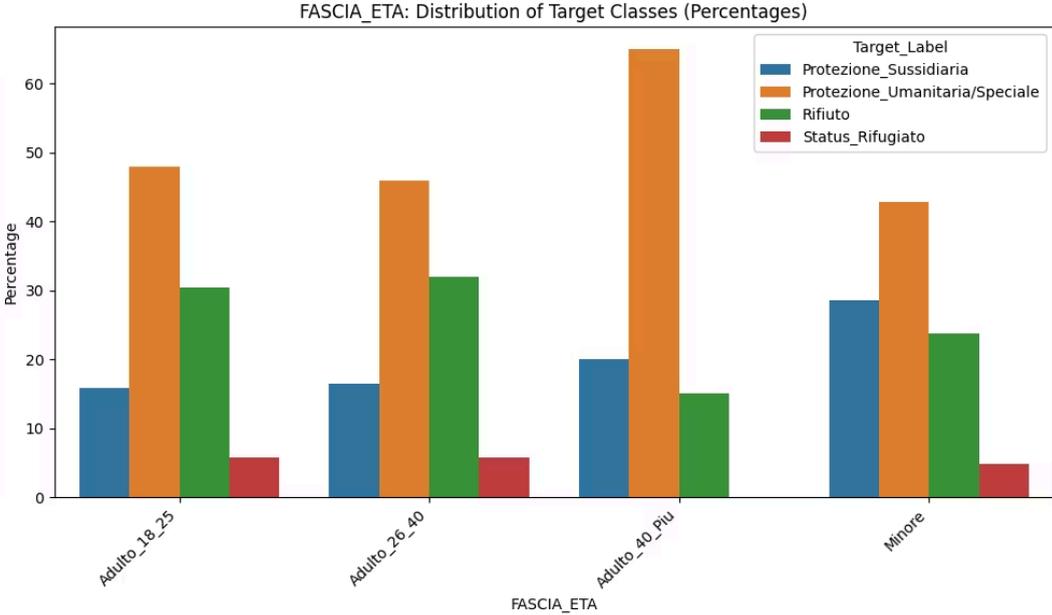
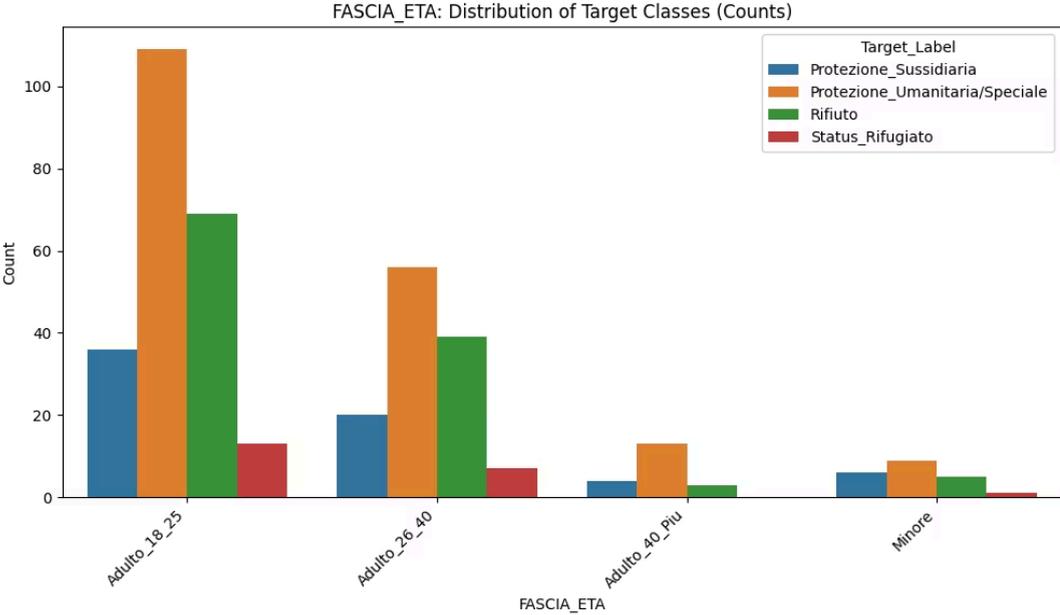
Case Distribution: Temporal Range



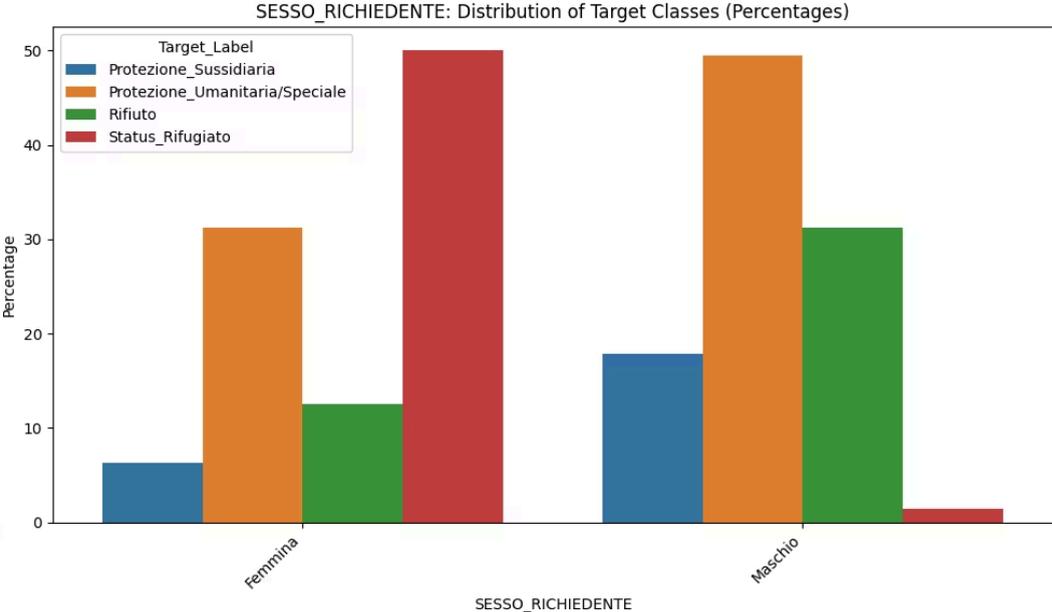
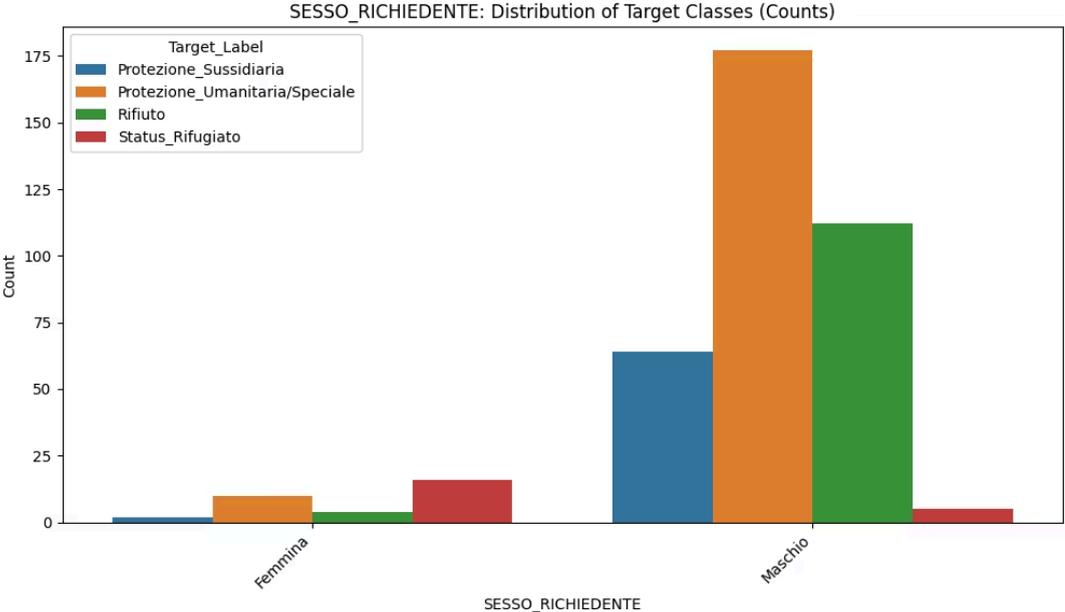
Case Distribution: Origin



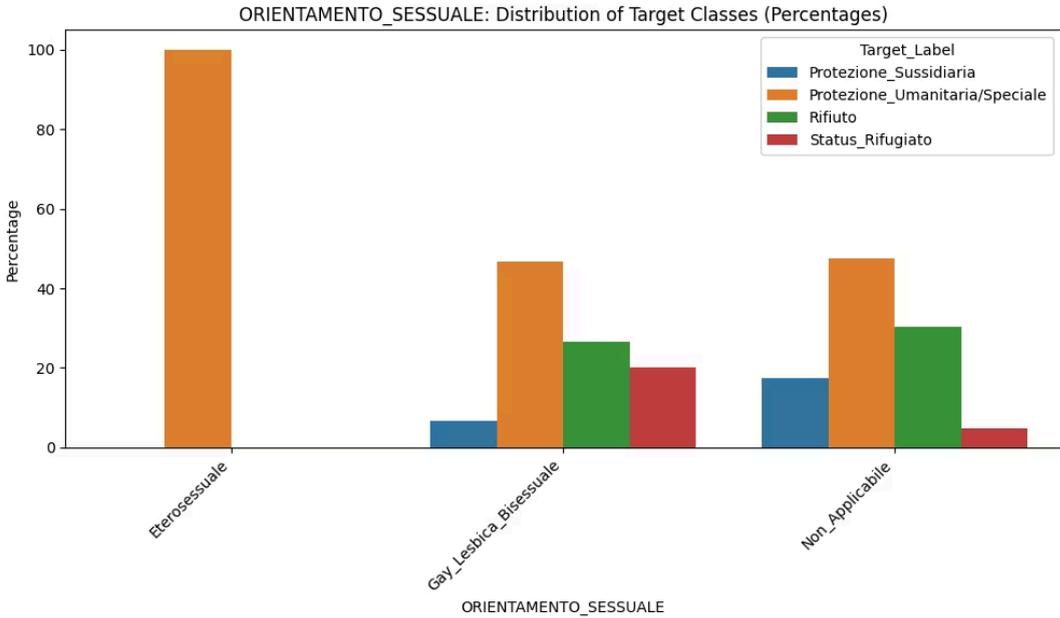
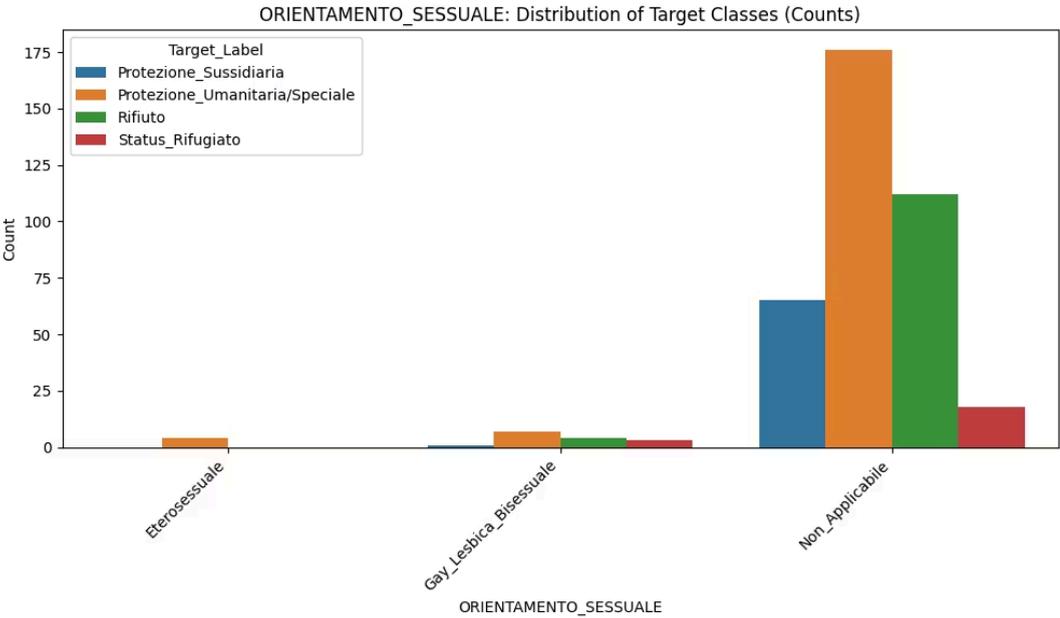
Case Distribution: Demographics



Case Distribution: Gender



Case Distribution: Sexual Orientation



Machine Learning Strategy: A Proxy for Decision Making

Objective

Build a predictor to model Tribunal decisions and identify contributing features.

Key Concept

This is a "proxy analysis"—identifying what the *model* uses to predict the decision, which serves as a proxy for what the tribunal might be weighing.

Data Preparation & Challenges

The Curse of Dimensionality

91 samples vs. ~1600 encoded features creates a high risk of overfitting.

Feature Redundancy

High collinearity detected among questions as many ask similar things.

Rigorous Validation

Implemented a **Nested Cross-Validation** pipeline.

- *Inner Loop*: Feature selection and hyperparameter tuning on training data only.
- *Outer Loop*: Evaluation on unseen data to prevent data leakage and provide realistic performance estimates.

Model Selection & Performance

0.886

Random Forest

Top performer with **F1-macro:**
0.886 (± 0.082).

0.837

Lasso

Strong baseline with F1-macro:
0.837 (± 0.071).

0.836

Gradient Boosting

Competitive but higher variance
(F1-macro: 0.836 ± 0.100).

0.571

Decision Tree

Poor performance (F1-macro:
0.571), likely due to overfitting on
the small dataset.

Expert Feedback & Validation: Methodology

Objective

Five legal experts received a questionnaire comparing the model's top predictive features against legal doctrine.

Analysis

Experts were asked if the features the model found "important" (via SHAP values) were legally relevant for granting *Subsidiary Protection* or *Humanitarian Protection*.

Subsidiary Protection - Valid Features

1

Religion

"La religione /credo/ fede professata dal/dalla ricorrente è vietata dalla legge/perseguitata nel suo paese di origine?"

Expert Analysis: Unanimously confirmed as highly relevant. Persecution based on religion is a core criterion for international protection.

2

Commission Reasoning

"Se la commissione territoriale ha accolto in modo parziale/rigettato la domanda del/della richiedente, perché (e.g., ha escluso la presenza di presupposti oggettivi e soggettivi...)"

Expert Analysis: The specific reasons for previous partial acceptance or rejection were deemed crucial for the Tribunal's re-evaluation.

Subsidiary Protection - Contested Feature

Family Problems

"La commissione ritiene rilevanti gli elementi relativi a problemi con i familiari?"

Expert Analysis: Flagged as irrelevant by some experts as it is a standard question.

Family Composition

"Come è composta la famiglia di origine del/della richiedente?"

Expert Analysis: Flagged as irrelevant by some experts as it is a standard question.

Humanitarian Protection - Valid Features

Non-Refoulement

"La commissione ritiene che esista un obbligo di non rimpatrio o non respingimento o che l'allontanamento comporti una violazione del diritto al rispetto della vita privata e familiare?"

Expert Analysis: Directly addresses the core legal test for humanitarian/special protection.

State Protection

"Se la corte ritiene o meno che in caso di rientro nel paese di origine il/la ricorrente riceverebbe dallo Stato un'adeguata protezione, perché?"

Expert Analysis: Assesses the safety of return, a fundamental pillar for granting protection.

Humanitarian Protection: Contested Features

Kidnapping

"Quali dettagli ricorda il richiedente riguardo al sequestro o rapimento?"

Expert Analysis: Humanitarian protection is not granted because the applicant suffered serious harm in the past, but to ensure future protection

Rejection - Valid Features

Exclusion Clauses

"Il tribunale ritiene che vi siano cause ostative alla concessione dello status di rifugiato?"

Expert Analysis: Even though they don't necessarily block other form of protection they usually lead to rejection.

Rejection - Contested Features

Procedural Openness

"Il richiedente vuole aggiungere ulteriori informazioni?"

Expert Analysis: Experts noted this is a standard closing question. The model likely found that applicants who have nothing more to add are statistically more likely to be rejected, but this is not a legal reason for rejection.

Family Composition

"Come è composta la famiglia di origine?"

Expert Verdict: Deemed irrelevant for the specific decision of rejection.

Asylum - Valid Features

Gender

"Qual è il sesso del richiedente?"

Expert Analysis: Gender is critical for claims involving trafficking or gender-based persecution.

COI Sources

"Se il tribunale ritiene che la situazione del paese... trovi riscontro in altre fonti quali sono queste fonti (e.g., rapporti EASO/OIM...)?"

Expert Analysis: Reliance on Country of Origin Information (COI) is the gold standard for validating asylum claims.

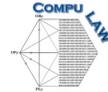
Asylum - Contested Features

Expatriation Date

"Quando è espatriata/o la/il ricorrente?"

Expert Verdict: The fact of persecution matters more than the date of departure, unless there is a specific regime change argument.

Thank You



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