DS3001 Final Project:
Predicting IMDb Ratings of New Films

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Abstract

Movies are a major part of global popular culture, and understanding what drives audience ratings is valuable for filmmakers, streaming platforms, actors, and investors alike. This project develops a predictive model for IMDb movie ratings, using published data from IMDb (the Internet Moive Database). Being able to determine rating predictions based on qualities known before the film comes out gives stakeholders of the film a chance to change plans to increase potential audience reception. We examine how attributes such as genre, runtime, release year, and crew members influence audience scores and implement common machine learning approaches (testing and training) to predict ratings. [RESULTS TO COME AT FUTURE STAGE OF PROJECT]

1. Data Description

IMDb provides publicly available, non-commercial datasets that contain extensive information about films, TV shows, and other media. These datasets include metadata such as release date, runtime, genres, cast and crew, and audience rating. For this project, the key variable of interest is average IMDb rating, which represents the weighted average of user-submitted scores. The object is to build a predictive model that estimates a movie's rating at the time of release, using information available beforehand such as genre, runtime, release year, and the historical success of it's directors and writers. IMDb updates their data frequently, our dataset reflects the version available as of September 26, 2025.

1.1. Variables of Interest

A description of the variables from IMDb.

Identifier / Helper Variables

- tconst (string) - alphanumeric unique identifier of the title
- primaryTitle (string) – the more popular title / the title used by the filmmakers on promotional materials at the point of release
- numVotes - number of votes the title has received

Target Variables (y)

- averageRating – weighted average of all the individual user ratings

Predictor Variables (x)

- startYear (YYYY) – represents the release year of a title.
- runtimeMinutes – primary runtime of the title, in minutes
- genres (string array) – includes up to three genres associated with the title
- directors (array of nconsts) - director(s) of the given title
- writers (array of nconsts) – writer(s) of the given title

1.2. Cleaning the Data

To prepare the data, we first combined the dataset title.basics.tsv.gz, title.crew.tsv.gz, and title.rating.tsv.gz using tconst as a primary key. Next, we dropped the unneeded columns in title.basics, specifically originalTitle, isAdult, and endYear. From there, we filtered the data to only keep rows where titleType equals "movie," to exclude TV shows and other types of media. All \N values were converted to NaN for consistency in handling missing data. To increase reliability, we filtered out movies with fewer than 500 votes and then focused our data to only include movies released after the year 2000. This ensures that reviews are more accurate on average and focuses the scope of our model to films from the "technological era". After filtering, we are left with 43,816 rows. Finally, we split the data into training and test sets (roughly 80% and 20%, respectively) with the training set including movies released between 2000 and 2020, and the test set including movies from 2020 to 2025.

1.3. Variable Engineering

In addition to the base variables, we created new features to capture historical performance and experience. For directors, we computed the average rating of their past films prior to the release year of the observed movie. For writers, we measured experience by counting the number of movies they had previously worked on. Lastly, because movies can be associated with up to three genres, we created dummy variables for each genre category to allow films to have multi-genre representation.

2. Format of the Paper

All submissions must follow the specified format.

2.1. Dimensions

The text of the paper should be formatted in two columns, with an overall width of 6.75 inches, height of 9.0 inches, and 0.25 inches between the columns. The left margin should be 0.75 inches and the top margin 1.0 inch (2.54 cm). The right and bottom margins will depend on whether you print on US letter or A4 paper, but all final versions must be produced for US letter size. Do not write anything on the margins.

The paper body should be set in 10 point type with a vertical spacing of 11 points. Please use Times typeface throughout the text.

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The paper title should be set in 14 point bold type and centered between two horizontal rules that are 1 point thick, with 1.0 inch between the top rule and the top edge of the page. Capitalize the first letter of content words and put the rest of the title in lower case.

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Section headings should be numbered, flush left, and set in 11 pt bold type with the content words capitalized. Leave 0.25 inches of space before the heading and 0.15 inches after the heading.

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2.6. Figures

You may want to include figures in the paper to illustrate your approach and results. Such artwork should be centered, legible, and separated from the text. Lines should be dark and at least 0.5 points thick for purposes of reproduction, and text should not appear on a gray background.

Label all distinct components of each figure. If the figure takes the form of a graph, then give a name for each axis and include a legend that briefly describes each curve. Do not include a title inside the figure; instead, the caption should serve this function.

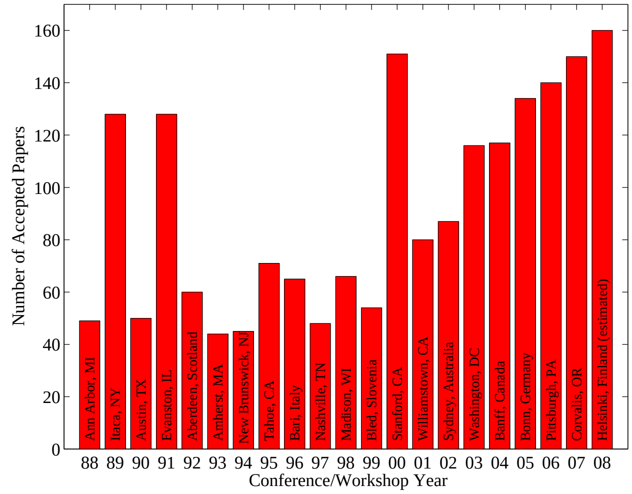

Figure 1. Historical locations and number of accepted papers for International Machine Learning Conferences (ICML 1993 – ICML 2008) and International Workshops on Machine Learning (ML 1988 – ML 1992). At the time this figure was produced, the number of accepted papers for ICML 2008 was unknown and instead estimated.

Number figures sequentially, placing the figure number and caption *after* the graphics, with at least 0.1 inches of space before the caption and 0.1 inches after it, as in Figure 1. The figure caption should be set in 9 point type and centered unless it runs two or more lines, in which case it should be flush left. You may float figures to the top or bottom of a column, and you may set wide figures across both columns (use the environment `figure*` in LaTeX). Always place two-column figures at the top or bottom of the page.

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If you are using LaTeX, please use the “algorithm” and “algorithmic” environments to format pseudocode. These require the corresponding stylefiles, algorithm.sty and algorithmic.sty, which are supplied with this package. Algorithm 1 shows an example.

2.8. Tables

You may also want to include tables that summarize material. Like figures, these should be centered, legible, and numbered consecutively. However, place the title *above* the table with at least 0.1 inches of space before the title and the same after it, as in Table 1. The table title should be set in 9 point type and centered unless it runs two or more lines,

[1] Footnotes should be complete sentences.

[2] Multiple footnotes can appear in each column, in the same order as they appear in the text, but spread them across columns and pages if possible.

Algorithm 1 Bubble Sort

Input: data x_i, size m
repeat
  Initialize $noChange = true$.
  for $i = 1$ **to** $m - 1$ **do**
    if $x_i > x_{i+1}$ **then**
      Swap x_i and x_{i+1}
      $noChange = false$
    end if
  end for
until $noChange$ is $true$

Table 1. Classification accuracies for naive Bayes and flexible Bayes on various data sets.

DATA SET	NAIVE	FLEXIBLE	BETTER?
BREAST	95.9$\pm$ 0.2	96.7$\pm$ 0.2	$\surd$
CLEVELAND	83.3$\pm$ 0.6	80.0$\pm$ 0.6	$\times$
GLASS2	61.9$\pm$ 1.4	83.8$\pm$ 0.7	$\surd$
CREDIT	74.8$\pm$ 0.5	78.3$\pm$ 0.6	
HORSE	73.3$\pm$ 0.9	69.7$\pm$ 1.0	$\times$
META	67.1$\pm$ 0.6	76.5$\pm$ 0.5	$\surd$
PIMA	75.1$\pm$ 0.6	73.9$\pm$ 0.5	
VEHICLE	44.9$\pm$ 0.6	61.5$\pm$ 0.4	$\surd$

in which case it should be flush left.

Tables contain textual material, whereas figures contain graphical material. Specify the contents of each row and column in the table's topmost row. Again, you may float tables to a column's top or bottom, and set wide tables across both columns. Place two-column tables at the top or bottom of the page.

2.9. Theorems and such

The preferred way is to number definitions, propositions, lemmas, etc. consecutively, within sections, as shown below.

Definition 2.1. A function $f : X \to Y$ is injective if for any $x, y \in X$ different, $f(x) \neq f(y)$.

Using Definition 2.1 we immediate get the following result:

Proposition 2.2. *If f is injective mapping a set X to another set Y, the cardinality of Y is at least as large as that of X*

Proof. Left as an exercise to the reader. $\square$

Lemma 2.3 stated next will prove to be useful.

Lemma 2.3. *For any $f : X \to Y$ and $g : Y \to Z$ injective functions, $f \circ g$ is injective.*

Theorem 2.4. *If $f : X \to Y$ is bijective, the cardinality of X and Y are the same.*

An easy corollary of Theorem 2.4 is the following:

Corollary 2.5. *If $f : X \to Y$ is bijective, the cardinality of X is at least as large as that of Y.*

Assumption 2.6. The set X is finite.

Remark 2.7. According to some, it is only the finite case (cf. Assumption 2.6) that is interesting.

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Use an unnumbered first-level section heading for the references, and use a hanging indent style, with the first line of the reference flush against the left margin and subsequent lines indented by 10 points. The references at the end of this document give examples for journal articles (Samuel, 1959), conference publications (Langley, 2000), book chapters (Newell & Rosenbloom, 1981), books (Duda et al., 2000), edited volumes (Michalski et al., 1983), technical reports (Mitchell, 1980), and dissertations (Kearns, 1989).

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The above statement can be used verbatim in such cases, but we encourage authors to think about whether there is content which does warrant further discussion, as this statement will be apparent if the paper is later flagged for ethics review.

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