
DS3001 Final Project:

Predicting IMDb Ratings of New Films

Jackson Haiz^{*1} Quinn Connor^{*12} Teagan Ryan²

Abstract

Movies are a major part of global popular culture, and understanding what drives audience ratings is valuable for filmmakers, streaming

- 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. 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 its 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.

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 1,000 votes and then focused our data to only include movies released after the year 2000. After filtering, we are left with 302,326 rows. We also created two new variables to measure the average rating of a director's past films and the number of movies each writer had previously worked on. Finally, we split the data into training and test sets (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.

2.2. Title

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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ICML uses double-blind review, so author information must not appear. If you are using \LaTeX and the `icml2025.sty` file, use `\icmlauthor{...}` to specify authors and `\icmlaffiliation{...}` to specify affiliations. (Read the TeX code used to produce this document for an example usage.) The author information will not be printed unless `accepted` is passed as an argument to the style file. Submissions that include the author information will not be reviewed.

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Affiliations should be numbered in the order of appearance. A single footnote block of text should be used to list all the affiliations. (Academic affiliations should list Department, University, City, State/Region, Country. Similarly for industrial affiliations.)

Each distinct affiliations should be listed once. If an author has multiple affiliations, multiple superscripts should be placed after the name, separated by thin spaces. If the authors would like to highlight equal contribution by multiple first authors, those authors should have an asterisk placed after their name in superscript, and the term “*Equal contribution” should be placed in the footnote block ahead of the list of affiliations. A list of corresponding authors and their emails (in the format Full Name <email@domain.com>) can follow the list of affiliations. Ideally only one or two names should be listed.

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The paper abstract should begin in the left column, 0.4 inches below the final address. The heading ‘Abstract’ should be centered, bold, and in 11 point type. The abstract body should use 10 point type, with a vertical spacing of 11 points, and should be indented 0.25 inches more than normal on left-hand and right-hand margins. Insert 0.4 inches of blank space after the body. Keep your abstract brief and self-contained, limiting it to one paragraph and roughly 4–6 sentences. Gross violations will require correction at the camera-ready phase.

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2.5.1. SECTIONS AND SUBSECTIONS

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.

Similarly, subsection headings should be numbered, flush left, and set in 10 pt bold type with the content words capitalized. Leave 0.2 inches of space before the heading and 0.13 inches afterward.

Finally, subsubsection headings should be numbered, flush left, and set in 10 pt small caps with the content words capitalized. Leave 0.18 inches of space before the heading and 0.1 inches after the heading.

Please use no more than three levels of headings.

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Within each section or subsection, you should further partition the paper into paragraphs. Do not indent the first line of a given paragraph, but insert a blank line between succeeding ones.

You can use footnotes¹ to provide readers with additional information about a topic without interrupting the flow of the paper. Indicate footnotes with a number in the text where the point is most relevant. Place the footnote in 9 point type at the bottom of the column in which it appears. Precede the first footnote in a column with a horizontal rule of 0.8 inches.²

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.

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.

¹Footnotes should be complete sentences.

²Multiple 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.

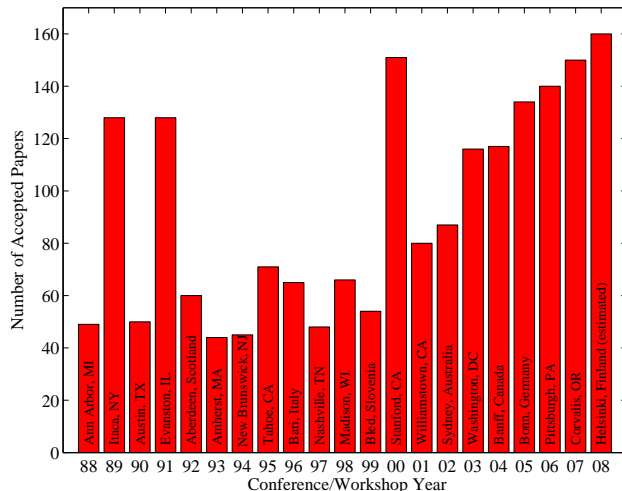


Figure 1. Historical locations and number of accepted papers for International Machine Learning Conferences (ICML 1993 – ICML 2008) and International Workshops on Machine Learning (ML 1988 – ML 1992). At the time this figure was produced, the number of accepted papers for ICML 2008 was unknown and instead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

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 $true$

2.7. Algorithms

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, in which case it should be flush left.

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

| DATA SET | NAIVE | FLEXIBLE | BETTER? |
|-----------|-----------|-----------|---------|
| BREAST | 95.9± 0.2 | 96.7± 0.2 | ✓ |
| CLEVELAND | 83.3± 0.6 | 80.0± 0.6 | × |
| GLASS2 | 61.9± 1.4 | 83.8± 0.7 | ✓ |
| CREDIT | 74.8± 0.5 | 78.3± 0.6 | |
| HORSE | 73.3± 0.9 | 69.7± 1.0 | × |
| META | 67.1± 0.6 | 76.5± 0.5 | ✓ |
| PIMA | 75.1± 0.6 | 73.9± 0.5 | |
| VEHICLE | 44.9± 0.6 | 61.5± 0.4 | ✓ |

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 $f : X \rightarrow Y$ is injective if for any $x, y \in X$ different, $f(x) \neq f(y)$.

Using Definition 2.1 we immediately 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 $f : X \rightarrow Y$ and $g : Y \rightarrow Z$ injective functions, $f \circ g$ is injective.*

Theorem 2.4. *If $f : X \rightarrow Y$ 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 $f : X \rightarrow Y$ 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.

2.10. Citations and References

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Citations within the text should include the authors’ last names and year. If the authors’ names are included in the sentence, place only the year in parentheses, for example when referencing Arthur Samuel’s pioneering work (1959). Otherwise place the entire reference in parentheses with the authors and year separated by a comma (Samuel, 1959). List multiple references separated by semicolons (Kearns, 1989; Samuel, 1959; Mitchell, 1980). Use the ‘et al.’ construct only for citations with three or more authors or after listing all authors to a publication in an earlier reference (Michalski et al., 1983).

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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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