

## Recommendation system & Time series

1] What is time series? explain different techniques used to make time series prediction.

- ① Time series contains sequence of data points which are indexed in an order. This order is basically the time in which the happened or recorded.
- ② The points are recorded at discrete time with equal time interval.
- ③ A time series is a set of observations  $X_t$ , each one being recorded at a specific time  $t$ .
- ④ And this series of data points ~~for time~~ collected in time order is known as time series.
- ⑤ ex. Average passenger travelled per day over years.
- ⑥ Different from supervised learning.
- ⑦ Time series forecasting is the way to predict the behaviour by using past data.
- ⑧ Different tech. used for making time series predictions.

1] Naive approach:-

- ① In this, we assume that the next expected point is equal to the last observed point.
- ② So, we can expect a straight horizontal line as the prediction.

2] Moving average:-

- ① In this tech., we will take the average of last observed point for last few time period only.



### ③ Simple exponential smoothing:-

- ① In this tech., we assign larger weight to more recent observations than to observations from distant past.
- ② The weight decrease exponentially come from further in the past. The smallest weights are associated with oldest observations.

### ④ HoT linear trend:-

- ① It is expansion of simple exponential smoothing to allow forecasting of data with a trend.
- ② This method taken into account the trend of datacast dataset.

Q. 2] explain different type of recommender system.

→ There are two types of recommender system:-

- ① collaborative filtering
- ② content-based filtering

#### ① collaborative filtering:-

- 1] It uses community data from peer groups for recommendation.
- 2] There exhibits all these things that are popular among the peers.
- 3] There filtering system recommend items based on similarity measures bet<sup>n</sup> users and/or items.
- 4] Here user file & contextual parameter along with the community data are used by the recommender system to personalize



Q. 3] explain different cosine similarity tech.

- ① Cosine similarity is a metric used to measure how similar the two items or documents are irrespective of their size.
- ② It measures the cosine of an angle bet<sup>n</sup>. two vectors projected in multi-dimensional space.
- ③ Mathematically, the cosine of an angle of bet<sup>n</sup>. two vectors is derived from the dot product of the two vectors divided by product of two vector's magnitude.

$$\text{Similarity}(p, q) = \cos \theta = \frac{p \cdot q}{\|p\| \|q\|}$$

$$= \frac{\sum_{i=1}^n p_i q_i}{\sqrt{\sum_{i=1}^n p_i^2} \sqrt{\sum_{i=1}^n q_i^2}}$$

$$\sqrt{\sum_{i=1}^n p_i^2} \sqrt{\sum_{i=1}^n q_i^2}$$

- ④ Since we find output cosine of two vectors the output will always range from -1 to 1. where -1 shows two items are dissimilar & 1 shows two items completely similar.

⑤ ex.

Assuming two documents Doc1 and Doc2.

Doc1 contains word "mouse" 5 times &  
word "cat" 12 times.

Doc2 contains word "mouse" 12 times &  
word "cat" 14 times.



$$\cos(\text{Doc1}, \text{Doc2}) = \frac{(5 \times 12) + (12 \times 4)}{\sqrt{5^2 + 12^2} \sqrt{12^2 + 4^2}} \quad \frac{25}{144}$$

$$= \frac{228}{\sqrt{169} \sqrt{340}} = \frac{228}{13 \times 18.43}$$

$$= \frac{60 + 168}{\sqrt{25 + 144} \sqrt{144 + 196}}$$

$$= \frac{228}{\sqrt{169} \cdot \sqrt{340}} = \frac{228}{13 \times 18.43}$$

$$\cos \theta = \frac{228}{239.59} = \underline{\underline{0.951}}$$

$$\theta = \cos^{-1}(0.95)$$

$$\theta = \underline{\underline{18.19}}$$

⑥ The cosine distance is the angle subtended at the origin bet<sup>n</sup> two documents. A value of 0 degrees represent identical document. and 90° represent dissimilar document.

Q. 4] explain characteristic of time series.

→ Characteristic of time series:

1. Trend

2. Seasonality

3. Cyclical movements

4. Unexpected variations



### 1] Trend :-

Trend is general direction in which something is developing or changing. So, we see an increasing trend in this time series.

Ex. - passenger count is increasing <sup>with</sup> the number of years.

### 2] Seasonality :-

1) The pattern is repeating at regular time interval which is known as seasonality.

2) An predictable change or pattern in time series that repeats over specific time period can be said to be seasonality.

3) seasonality manifests as repetitive & period variations in time series.

3) A practical tech. of determining seasonality is through exploratory data analysis through the following plots:

- Run sequence plot
- Sequence sub series plot
- Multiple box plots.

### 3] Cyclical changes :-

① cyclic changes are movements observed after every few units of time. but they occur less frequently than seasonal fluctuations

② Unlike seasonality, cyclical changes might not have a fixed period of variations.

### 4] Unexpected variations :-

① Unexpected variations cannot be framed in mathematical model for a definitive future prediction.



Q.5] explain collaborative filter based recommender system.

Neighbourhood-based recommendation system:-

- ① Neighbourhood-based recommender systems consider the preferences or like of the user community or users of neighbourhood of an active user before making suggestions or recommendations to the active user.
- ② The idea of neighbourhood-based recommender is very simple: given the rating of a user, find all the users similar to active user who had similar preferences in past & then make predictions regarding all unknown products that the active user has not rated but are being rated in by his neighbourhood.

Types:-

- User-based collaborative filtering
- Item-based collaborative —

- ③ collaborative filtering is the process of filtering for information or patterns using techniques involving collaborative among multiple agents, viewpoint, data source etc.

- ④ User-based collaborative filtering :-  
User based collaborative filtering first finds out the similarity bet<sup>n</sup> the active user & other users.

- ⑤ Identifies the similar users based on Euclidian distance or correlation coeff.

Recommend the products that has not rated/purchased by active user but rated by similar/nearest users.

ex. Movie Recommendation.



### ⑥ Item-based collaborative Filtering :-

Item-based collaborative filtering recommends systems unlike user-based collaborative filtering, we use similarity bet<sup>n</sup> items instead of similarity bet<sup>n</sup> users.

Q.5] What is recommender system? why it is needed? list application of recommender system.

- ① Recomm system are the system that are designed to recommend things to the user based designed to on many different factors.
- ② These systems predict the most likely product that the user can most to purchase and are of interest too.
- ③ companies like Netflix, Amazon etc. use recommendation system to help their user to identify the correct product or movies for them.
- ④ The recommender system deals with a large volume of information present by filtering the most imp info based on data provided by user & other factors that take care of the user's preferences & interest.

Needed :-

- ① Because it helps user to find items of their interest.
- ② help the providers in advertising their items to the right user.



③ identify products that are most relevant to user.

④ personalized content.

⑤ help websites to improve user engagement.

Applications :-

- 1) recommending movies, music, television programs
- 2) recommending websites
- 3) Job recommendation
- 4) Friend recommendation
- 5) product recommendation.

Q.7] explain diff. type of recommender system.

→ 1] Neighbourhood-based recomm. engines:-

— Neighbourhood-based recomm. systems consider the preferences or like of the user community or users of neighbourhood of an active user before making suggestions or recommendation to active user.

— Assumptions — ① people with similar preferences in past have similar preferences in future.

② People's preferences will remain stable and consistent in the future.

— Type — ① user-based collaborative filtering

② item-based — — —

2] Personalized recommendation engines-

① content based recommendation system:-

A recomm. that is targeted at a personalise level & that consider ind preferences & content of product for generating recommendation is called Content-based recomm. system.



— ② content-aware ~~see~~ recomm. system.

3] Model-based recomm. engines:-

- ① ML based recomm. engine.
- ② classification - SUM/KNN
- ③ Matrix Factorization
- ④ Singular value decomposition
- ⑤ alternating le
- ⑥ Hybrid recomm. engines

Q. content based recomm. system / filtering

- ① A recomm. that is targeted at a personalized level & that considers individual preferences & contents of the product for generating recomm. is called content-based recommender system.
- ② They solve the cold-start problem that new user face in the collaborative filtering approach.
- ③ When a new user comes, based on preferences of the person we can suggest new items that are similar to their tastes.
- ④ Building content-base recommender system involves these main steps, as follows:
  1. Generating a content info for products.
  2. Generating a user profile & preferences with ~~see~~ respect to features of products.
  3. Generating recomm. & predicting a list of items that the user might like.