Stochastic Modelling Term Project

Abstract

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Modelling Customer Journey Using Markov Chains

Website tracking, i.e. tracking of users and their digital habits, is a pervasive phenomenon used by organizations, companies, websites etc. to gain insight into their users, their behaviour and preferences. These insights serve to optimize user-friendliness and experience, as well as for statistical purposes, for customization, for commerce, and for profiling and targeted marketing.

When a user browses on the internet, everything might potentially be tracked:

- The user's queries in search engines
- The sites the user visits
- The frequency of a user's return visits to a site
- What the user clicks on
- How long the user lingers on a site
- The speed with which the user scrolls
- Where the user stops
- The movements of the mouse around a webpage
- The comments and reactions the user might add on a site or on social media

Webshops and E-commerce websites track users in order to maximize their turnover. Websites also allow for third party advertisers to track their users and display ads to them in order to get revenue from their website.

Several qualitative analysis, statistical modelling and machine learning techniques have been employed to study consumer behaviour. We plan to build to model the journey of a customer through the following stages:

1. Information search
2. Alternative evaluation
3. Purchase decision

using Markov-Chain analysis.
Understanding the customer journey will enable organisations to focus on consumer-centric marketing. The sequence of actions each customer takes online creates a unique journey map and when data from many such users is collected an extensive graph of different states, transitions and probabilistic decisions can be created.
Probabilities of purchasing certain items can be computed, expectations of sales can be predicted using different inter-connected Markov chains.

BASIC FRAMEWORK

- On a very basic level **tracking existing and, potential customers** can be done using a simple **Markov chain or a Birth and Death Process**.
- Separate Markov Chains can be used to model purchases, advertisements, the user clicks etc where the transitions between states would respectively be defined as purchasing a certain item given a history of purchases, viewing a certain ad after some other ad has been viewed and clicking certain links or items after clicking history.
- These Markov Chains would provide information which when aggregated can be used to **predict with high confidence the future actions** of different customers.
- Apart from predicting user actions, the analysis would also enable organisations in decision making regarding advertisements and other marketing strategies.

  After such a basic analysis each component of the system can be studied in-depth and complex parameters can be used to model the system to achieve a higher level of insight and make much more accurate predictions and decision making.

- **Customer personas** need to be defined and modelled so as to do a macro-level analysis where people can be **clustered** together based on some **similarity index**.
- Present and potential customers are modelled on various parameters like likes/dislikes, consumption patterns, psychological and personal motivations.
- The above parameters can help us to model the state of a consumer and also help in calculating probabilities with respect to different decision-making processes.
- A consumer searches for information by visiting various web pages and sites. In so doing he/she expands his/her **knowledge-base**, resulting in the formation of an **evoked/consideration** set – the suite of alternatives from which the ultimate purchase will be made.
- Variables such as **activity before making a purchase** and **time spent before making the next click** will help to identify some patterns in user behaviour and at the same time helping organisations to make **decisions like which products/advertisements to show together.**
- A **temporal sequence** can be identified which will enable to analyse which type of advertisements will lead to the user to view and click certain types of products. Therefore apart from first-order transitions, **higher-order Markov processes** can be used to model the relationships between customers and entities with respect to time.
- Apart from a time-based analysis, an **aggregate inference** can be made about how much **time the user is likely to spend on some website**, mapping user interests with different types of products etc.
- Thus a detailed analysis using Markov Chain analysis and understanding of the different variables that affect consumer behaviour and marketing strategies various insights can be gained which will add value to any business or organization.