UNIVERSITY OF TARTU
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Computer Science Curriculum

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Price Elasticity Based Recommender System

Master's Thesis (30 ECTS)

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Abstract:

Recommender systems have been widely studied and successfully applied in a variety of areas to increase sales by guiding people toward items they are more likely to find interesting. The aim of this thesis is to develop a novel recommender system that suggests items to a client based on the appeal of a product discount. This can be applied to situations where recommendations are made from a list of discounted items such as campaign products selected into personalized sales promotion letters. To take into consideration that the products have cheaper price than usual during the campaign period, we propose an extension to an item based collaborative filtering algorithm, namely the price elasticity of demand known from the field of economics. We represent a client's rating about an item by estimating with a model own elasticity which measures the sensitivity of quantity demanded to the changes in the prices. The similarities of items are computed using cross elasticity which exhibits the substitutional and complementary effects among the products. Unlike traditional similarity metrics, this measure does not assume that the two items have to be purchased by the same clients. The proposed recommender system based on the price elasticity is applied to a real world supermarket transactions dataset. The performance of the system is evaluated on two campaign periods where recommendations are made from the discounted products. The experiments show that it is better to make recommendations based on only campaign product elasticities, without considering the elasticities of campaign products' substitutes. Furthermore, when including only the customers for whom we have found at least 5 recommendations, the performance is considerably better. In particular, when making 10 suggestions (less than 1% of all campaign products), we detect all campaign products that the clients indeed purchased. Using the best method, our approach achieves precision of 0.24, which is over 10 times better in comparison to the method currently used by the company where employees manually select recommendations based on the characteristics of customer segments. The supermarket chain has confirmed their interest in testing the proposed method in practice, hence it will be applied in real world to make more relevant recommendations to the customers.

Keywords: recommender system, collaborative filtering, price elasticity of demand

CERCS: P170 Computer science, numerical analysis, systems, control

Hinnaelastsusel tuginev soovitussüsteem

Lühikokkuvõte:

Soovitussüsteeme on palju uuritud ja edukalt rakendatud paljudes valdkondades, et klienditele asjakohaseid soovitusi tehes suurendada läbimüüki. Käesoleva magistritöö eesmärgiks on välja töötada uudne soovitussüsteem, mis teeb klientidele personaalseid pakkumisi tuginedes toote soodushinna huvipakkuvusele. Seda saab rakendada olukordades, kus soovitusi tehakse allahinnatud toodete seast, näiteks valides kampaaniatooteid kliendile saadetavasse personaalsesse uudiskirja. Kaasfiltreerimise algoritmile lisame majanduse valdkonnas kasutatava nõudluse hinnaelastsuse, et arvestada toote tavapärasemast madalamat hinda kampaaniaperioodil. Kliendi tootereitinguna kasutame mudeli abil hinnatud omaelastsuse väärtust, mis näitab, kuidas hinna muutumine mõjutab ostetavat kogust. Toodete sarnasused leiame ristelastsusega, mis liigitab tooted asendus- ja täiendkaupadeks. Ristelastsus ei nõua tihti esinevat kaugusmõõtude tingimust, et kaks toodet peavad olema ostetud samade klientide poolt. Kirjeldatud soovitussüsteemi rakendame reaalsetele supermarketi tehingute andmetele. Süsteemi headuse hindame kahel kampaaniaperioodil, mille allahinnatuid tooteid kasutame võimalike soovitustena. Märgatavalt paremad tulemused saavutame, kasutades ainult kampaaniatoote elastsusi, mitte asendustoodete vastavaid väärtusi. Tunduvalt paremad tulemused saame klientidele, kellele leidsime vähemalt 5 pakkumist. Täpsemalt, tehes neile klientidele 12 soovitust (vähem kui 1% kampaaniatoodete arvust), tabame nende kõik kampaaniatoodete ostud. Parim kordustäpsus on 0,24. See on üle 10 korra parem kui ettevõtte kordustäpsus hetkel kasutatava meetodiga, kus soovitused on manuaalselt valitud kliendi segmentide omaduste põhjal. Supermarketi kett soovib esitletud meetodit testida, seega antud soovitussüsteemi rakendatakse lähitulevikus klientidele huvipakkuvate soovituste tegemiseks.

Võtmesõnad: soovitussüsteem, kaasfiltreerimise algoritm, nõudluse hinnaelastsus

CERCS: P170 Arvutiteadus, arvutusmeetodid, süsteemid, juhtimine (automaatjuhtimisteooria)

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