Chapter 15
Physician Prescribing Practices

Mussie Tesfamicael
University of Lousiville, USA

ABSTRACT
The purpose of this project is to develop time series models to investigate prescribing practices and patient usage of medications with respect to the severity of the patient condition. The cost of medications is rising from year to year; some medications are prescribed more often compared to others even if they have similar properties. It would be of interest to pharmaceutical companies to know the reason for this. In this case, we predict the cost of medications, private insurance payments, Medicaid payments, Medicare payments, the quantity of medications, total payment and to study why the cost is rising in one medication compared to others. We investigate how much patients are spending on average for their prescriptions of medications, taking the inflation rate into account as a time-dependent regressor. Both forecasts, the one that incorporates the inflation rates and the one that does not are compared.

BACKGROUND
There are over 100 antibiotics in the market, but the majority of them come from only a few types of drugs. The main classes of antibiotics are Penicillin, such as penicillin and Amoxicillin, Cephalosporin such as Cephalexin (Keflex), Macrolides such as erythromycin, Clarithromycin and Azithromycin (Zithromax), Fluoroquinolones, such as ciprofloxacin (Cipro), Levoflaxacin (Levaquin), and Tetracycline such as Tetracycline and Doxycycline (Vibramycin). In this project, we will study the cost analysis of these antibiotics in relation to time. (Mol, et. al., 2005)
Antibiotics are among the most frequently prescribed medications. Antibiotics cure disease by killing or injuring bacteria. The first discovered antibiotic was penicillin, which was discovered from a mold culture. Today, over 100 different antibiotics are available to doctors to cure minor discomforts as well as life-threatening infections.
Antibiotics only treat bacterial infection, although they are used in a wide variety of illnesses. Antibiotics do not cure viral infections such as the
Physician Prescribing Practices

common cold; nor can they treat fungal infections. (Mol, et al., 2005) Most antibiotics have two names, a brand name created by the drug company that manufactures the drug and a generic name based on the chemical composition of the drug. The main purpose of this study is to develop time series models to forecast the cost of medications and to classify patient usage of medications with respect to patient conditions using text-mining clustering. We will also study on average how much patients are spending on medications.

SETTING THE STAGE

The purpose of this study is to examine the use of time series forecasting and data mining tools to investigate the prescription of medications. The specific objective is to examine the relationship between the total payments, private insurance payments, Medicare payments, Medicaid payments, number of prescriptions and quantity of prescriptions for different antibiotics. Currently, there are no methods available to forecast medication prescription costs, so we have adopted several methods that will help health care providers and hospitals to know about the prescription of the antibiotics prescribed. The payment made for each antibiotic is based upon an average cost and total cost that will include the cost of the antibiotics and insurance payments. It will be beneficial to show health care providers the trends of these medications in terms of the cost analysis. It is also beneficial to make comparisons between several antibiotics in terms of the number of prescriptions and to do further study as to why one medication is prescribed more often than others.

We developed time series models that will be used to forecast the prescription practices of the antibiotics. We used exponential models to develop forecasting for antibiotics on which cost increases exponentially. We also developed an autoregressive integrated moving average model for non-stationary data on which the series has no constant mean and variance through time. We developed Generalized Autoregressive Conditional Heteroskedastic Models for volatile variance, and we also incorporated the inflation rate as a model dynamic regressor to see the effect on model forecast. We finally used text mining and clustering to classify the ICD-9 codes into six clusters and make comparisons within each cluster, by plotting the data using kernel density estimation.

In this study, we use medications listed in the Medical Expenditure Panel Survey. The Medical Expenditure Panel Survey provides actual reimbursement information from private insurers, government agencies, and payments by patients. It provides summaries of all contact with the healthcare industry for a cohort of patients. (J. W. Cohen, et al., 1996; S. B. Cohen & Cohen, 2002; Newacheck, et al., 2004) With this information, studies have examined the specific costs of chronic diseases such as asthma, diabetes, and congestive heart failure. (Chan, et al., 2002; S. B. Cohen, Buchmueller, Cohen, & Buchmueller, 2006; Guevara, et al., 2003; Halpern, Yabroff, Halpern, & Yabroff, 2008; Law, et al., 2003; McGarry, Schoeni, McGarry, & Schoeni, 2005; Miller, et al., 2005; Newacheck, Kim, Newacheck, & Kim, 2005) However, because many patients have comorbidities, it is extremely difficult to isolate the treatment for one particular chronic disease.

CASE DESCRIPTION

We begin with an exponential smoothing model building to forecast the prescription of medications for the antibiotics dataset. Exponential smoothing models are characterized by giving heavier weights to recent events and lower weights to past events. Before we build a model for the prescription of medications, we set the fit period and evaluation period. The fit period is the period on which the model fits the data while the evaluation period is the period where we evaluate the model we built. We used a holdout sample of 20% of the total