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Team Phoenix: Predicting Patient Pay and Identifying Insurance Formularies

When a patient purchases medication at a pharmacy, the out-of-pocket cost is determined by a complex set of negotiations between **pharmacies**, **insurance companies**, and **drug manufacturers**. There are a wide array of different kinds of coverage plans for prescription drugs, which generally separate drugs into different **multi-tiered formularies**. For each plan and within each tier, coverage is determined by differing **deductibles**, **coinsurance**, and **copays**. Moreover, the effect of third-party discounts, such as those from the drug manufacturers or other agents, further complicates the calculation of patient pay. Due to these complicated factors, **actual out-of-pocket expenses are difficult to predict**.

While information about insurance formularies and drug discount programs are in principle publicly available, this information is spread out and hard to aggregate in one place. In contrast, **actual pharmacy transaction data is available in large abundance**. For example, CoverMyMeds provided us with a data set of just under 14 million pharmacy transactions. Although this data is simulated, it presents similar opportunities and challenges as the real-world data that companies like CoverMyMeds have access to. **Understanding** and being able to **accurately model** large-scale pharmacy transaction data is relevant to a variety of stakeholders, including **healthcare providers**, **pharmacies**, **insurance companies**, **drug manufacturers**, and most of all **patients**, for whom out-of-pocket medication costs may seem surprising or even unfeasible, even when equivalent medication may be available at a lower cost.

In our project we have done three main things. First, we have **predicted patient pay accurately** with an average 4% MAPE error. Since most of the differences between predicted and actual patient pay were seen for copays before the deductible phase, we recommend building another model for predicting copay before the deductible phase. Second, we have developed a method for **identifying the pricing model** of each insurance plan, as well as the **formulary status of each drug**, within these pricing models. Thirdly, we have **clustered drugs** according to the diseases they commonly treat. In future work, these three modeling approaches can be combined into a useful product for patients. Such a product will aid patients in choosing between different insurance plans, knowing when third-party discounts may be available, and in choosing among alternative medications when prices are unnecessarily high.