

Portfolio of MSSP Project

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1. Overview

The purpose of this portfolio is to show my project experiences as a MSSP student on collaborative consulting projects. Throughout two semesters, students in MSSP as well as teaching fellows formed the consulting group and our services included free walk-in problem solving sessions, statistical application consulting and long-term collaborative projects. We provided assistance with the following steps: Project planning, selection of appropriate statistical methods, data analysis and evaluation of results, and report and presentation development.

This portfolio includes five main projects:

- How sub-specialized are US physicians and what is the impact of super-specialization
- BU Athletics
- HAE (Hereditary Angioedema) Awareness Trial and Usage (ATU) among patients and physicians (HCPs)
- BU Physical Therapy Data Analysis
- BU Genetic Counseling Program Data Analysis

Each of the project consists of sections which summarize the background, data, modeling and conclusion. Due to some restrictions, some data and codes of projects remain confidential.

2. How Sub-Specialized Are US Physicians and What is the Impact of Super-specialization

This is a collaborative project conducted by the MSSP consulting team and Trinity Partners, LLC.

2.1 Introduction & Background

Specialists are those who have received additional training in a specific disease area/age/group/technique. While specialties can be broad, we suspect that some physicians focus on and become experts in specific diseases, i.e., they become “super-specialists”. So, as a global life sciences strategic consulting company, Trinity Partners is interested in whether this could lead to better care and what about those patients that don’t see a super-specialist – do their outcomes differ?

2.2 Data Description

The data we used was from Centers for Medicare and Medicaid Services (CMS) and was included following Datasets: Neurologist Physicians, Patients, Claims, ICD (International Classification of Diseases), NPI (National Provider Identifier), Enrollment, Revenue. The data was collected between 2010 to 2015.

2.3 Modeling & Analysis

Based on project objective, we examined Medicare claim data to understand the degree of super-specialization among neurologists in the US for three specific diseases-multiple sclerosis (MS), ALS and Alzheimer’s Disease (AD). Then, we compared patient outcomes financially between those receiving and not receiving care from a super-specialist by building linear regression models. To make more reasonable comparison, we used Propensity Score Matching before we get deeper analysis.

Propensity Score is the probability of being assigned treatment conditional on observed covariates, which we denote as $P(T = 1|X)$. Here X indicates a matrix of all pre-treatment covariates, T indicates binary treatment corresponding to care from super-specialist. T is 1 where patient receives care from super-specialist and is 0 when patient receives care from specialist.

Propensity score matching entails forming matching sets of subjects in case and control groups, who share a similar value of the propensity score. Subjects in case and control groups that are paired are close to each other, which is done by using nearest neighbor matching method.

2.4 Conclusion

For ALS, after Propensity Score Matching, we found that super-specialist tends to decrease annual claim cost by 30 %.

For MS, trend shows a slight negative slope in average monthly cost of care. However, there is not enough evidence to make declarative statement.

For AD, with our classification of super-specialists and our choice of outcome variables, we found that super-specialist does not seem to reduce costs for AD patients.

2.5 Discussion

There were some data limitations in this project, which includes:

- Using Medicare Data: 5% of total Medicare data
- Highly specialized practitioners may not accept Medicare
- Patients potentially have primary insurance on top of Medicare

2.6 Appendix

MS Society official website: <https://www.nationalmssociety.org/>

3. BU Athletics

3.1 Introduction & Background

Our client met with our team seeking to compare the effectiveness of two leadership development programs offered to first-year BU Division 1 athletes in Fall 2017. One offering consisted of three evening sessions and offered no course credit; the other was a one credit course consisting of eight sessions taught by our client. Students in both offerings were given surveys at the first session and last session that sought to measure certain constructs of interest: in particular, personality mindset, leadership mindset, grit, and performance. The client has conducted extensive research regarding the measurement of these constructs. The client is particularly interested in measuring changes (pre course versus post course) with respect to the aforementioned constructs.

3.2 Data Description

Response for pre & post survey for one credit course and no credit course.

There are 42 students from the evening session offering that submitted full (i.e., no missing questions) pre- and post- offering surveys and 31 from the one-credit-course.

3.3 Modeling & Analysis

Our analysis took place in two stages: first, we validated the measurement of the constructs by computing the Cronbach's alpha score for each construct. Each construct had a Cronbach's alpha in excess of 0.7, indicating adequate internal reliability. After validating the internal measurement model, we carried out paired t-tests for each construct for each offering. For instance, for the personality mindset construct, we have a 'before' and 'after' measurement for students in the night offering and students in the one credit course. The parameter of interest in these tests is the population mean difference. Our null hypothesis is that the difference of population mean is zero; that is, on average, there is no pre versus post course difference between the personality mindset scores. In the case where we reject the null hypothesis, then we can say there is a significant difference in the before versus after scores (with respect to some pre-specified α level).

3.4 Conclusion

In summary, our analysis indicates that the construct scores did not change significantly for students enrolled in the night sessions. For the one credit course, there was a significant increase in the personality mindset score (at the $\alpha = 0.05$ level). For the other constructs, there was no significant difference.

3.5 Discussion

After our conclusion, we came up two points that may contributed to later analysis. First, adding a quality checking part on the survey process could be more helpful for handling missing data, which lead to larger

sample sizes. Second, due to our client interest and purpose for the courses, we could design another survey which has a larger time span, maybe one year or four years when they are graduate, and that may lead to more obvious changes.

4. HAE (Hereditary Angioedema) Awareness Trial and Usage (ATU) Questionnaire Analysis

This is a collaborative project conducted by the MSSP consulting team and Shire Plc.

4.1 Introduction & Background

HAE is a rare and potentially life threatening genetic condition which causes serious swelling of patients and thus leads to dangerous situations. The main interest of this project is to understand the market of Hereditary Angioedema (HAE) products and create market segmentation for both HAE patients and health practitioners.

4.2 Data Description

The data we used for this project are responses of two waves of questionnaires. Each wave is divided into two sub-surveys, with one survey conducted on HAE Health Care Provider (HCP) and another conducted on HAE patients. For convenience, we assume there is 50% overlap between Wave 1 and 2 for both HCP and Patients. The wave 1 and wave 2 questionnaires are designed to have 85% of questions in common. The difference between Wave 1 and Wave 2 is that wave2 questionnaires have distinct sections which specifically designed to examine the effects on a new HAE drug: Haegarda.

4.3 Modeling & Analysis

The market segmentation of HAE treatment products can be divided into 2 parts: market segmentation of patients, and market segmentation of HCP. Our team is responsible for creating the market segmentation of HAE patients.

We first started by subtracting dimensions using factor analysis where we obtained factors from questions that correlate the most to the questionnaires. Based on the obtained factor results, we used hierarchical clustering method to segment HAE patients from each wave into four clusters. We then examine patients' characteristics in each cluster and build segmentations for HAE patients.

We divide patients into four segments, loyal customer, good customer, potential customer and problem customers. Most of loyal customers are well controlled female who are aged between 30 and 40 years old. They are working full time with an average annual income of \$75,000. They are mostly likely living in suburban area and are currently taking both acute and preventative treatment. For good customers, they are a mix of full-time working male and female aged between 30 and 40 years old. Most of them are located in urban area and with an average annual income falling in the range of \$50,000-\$75,000. They are more likely to have good control of HAE symptoms and are taking on both treatments or acute treatment only. The potential customers consist of mostly well controlled female aged from 40 to 49 years old who work either part-time or full-time and reside on rural or suburban areas.

4.4 Conclusion

Based on the market segmentation we created for HAE patients, we came up with some suggestions on future marketing strategies for Shire. First, we suggest Shire to emphasize on enhancing their relationship with loyal customers and good customers. To be more specific, Shire can maintain customer loyalty by building potential long term rewards programs and providing product support services. Secondly, we suggest Shire to offer more incentives to potential customers by increasing exposures of Shire products on medical websites (i.e., HAEA, Shire) and patients' communities. The last suggestion is to strengthen Shire's brand value by improving patients' awareness on Shire products by giving more information on clinical trials and the support program.

5. BU Physical Therapy Data Analysis

5.1 Introduction & Background

Our clients have provided patient level outcome data from the BU Physical Therapy and Athletic Training Center. Outcomes are measured in several ways: the difference in the intake versus discharge pain score, the difference in the intake versus discharge level of disability measurement (which is based on a survey depending on the patients' injury type), and the length of stay. The first question we address is whether patient outcomes are different across cohorts. This investigation seeks to gauge whether the increased level of data collection for the second cohort is associated with different outcomes. Second, using the data from cohort 2, we investigate whether outcomes differ depending on certain factors including gender, age, and body region of injury.

5.2 Data Description

Excel datasheets with measurements taken at each visit.

The data can be separated into 2 cohorts (one from 2014-2015 and one from 2016-2017). The distinguishing feature between the cohorts is that patients in the more recent cohort (cohort 2) were measured more frequently than patients in the first cohort on pain and disability (at each visit versus sporadically).

Cohort 1 is "Pre-Compliance", which measurements taken sporadically, and cohort 2 is "Post-Compliance", which measurements taken at each visit. Patient Outcomes includes following items, change in survey-measured pain & disability score, change in self-reported pain and disability score, length of stay and number of visit.

5.3 Modeling and Analysis

First, in order to define change, we use raw score change and hake score change.

Hake Gain Score is a measurement of normalized gain of improvement, i.e., how much the patient improved divided by how much they could have improved.

For Question 1, we first did EDA to get an overview of the patient outcomes and then involved in t-test to compare the mean of patient outcomes across two cohorts.

For Question 2, we built a linear regression model to find the impact of external variable which is related to patient outcomes, including gender and pain location.

5.4 Conclusion

After two sample t-test, we found that only change in self-reported pain has significant difference across cohorts. For survey-measured pain, raw score is increased for both cohorts, which means that they did recover better.

From the models, patient outcomes are not dependent from gender, age, and body regions. Also, length of stay is dependent from age and gender.

6. BU Genetic Counseling Program Data Analysis

6.1 Introduction & Background

This study aims to better understand the current climate for the usage of personal genetic testing in genetic counseling training programs. Active, board certified genetic counselors were asked to comment on any experience with the practice during their time in a training program as well as share their opinion on the idea in general. The client is particularly interested in how the views of ‘leaders’ compares with ‘non-leaders.’ For the purpose of this study, leaders are comprised of genetic counseling program directors, assistant program directors, and clinical coordinators.

6.2 Data description

Sentiment towards personal genetic testing is measured in several different ways by Question 8 and Question 11 of the survey. below, we examine whether sentiment towards personal genetic testing (as measured by the sub-parts of Q8 and Q11 of the survey) differ for leaders and non-leaders. In question 8, the respondents are asked to rate the appropriateness of 8 different kinds of genetic testing (response categories: “absolutely inappropriate,” “somewhat inappropriate,” “neutral,” “somewhat appropriate,” “absolutely appropriate.”) In question 11, respondents indicate their level of agreement (5 levels) with 11 factors regarding the issues concerning the use of personal genetic counseling in the classroom setting. We aim to understand whether the response distributions for leaders and non-leaders is significantly different.

6.3 Modeling and Analysis

We use chi-square tests of independence to evaluate whether the response distributions for leaders and non-leaders is significantly different. We carry out a test for each sub-question of Question 8 and Question 11. The null hypothesis of this test is that the response distribution is independent of leadership status.

6.4 Conclusion

For question 8, leaders and non-leaders have the same attitudes regarding the appropriateness of all listed forms of personal genetic testing. In question 11, for sub questions number 1, 2, 5, 6, 9, and 10, we do see some differences across response distributions, which means that the statement in these sub questions is dependent on leadership roles. This suggests that leaders and non-leaders have a slightly different understanding of what constitutes ‘appropriateness’ of use.