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MEASURING THE COST OF LIFE STYLE

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ABSTRACT

This paper reports preliminary results of a statistical analysis of life style markers and their relation to medical claims filed by employees under company medical plans. The markers include blood pressure, body mass index, total cholesterol, and smoking status. The relationship was modeled using linear regression methods.

INTRODUCTION

Good/poor life style choices are evident in what we eat, how we exercise, if we smoke, and how we monitor biometric markers of health. If we eat properly, exercise as recommended, abstain from smoking as warned, and seek periodic professional monitoring of the body's responses to such, we can expect good health and low cost maintenance of good health. Over time, the consequences of the life style choices we make are measurable in the reimbursements funded by employee and employer supported medical claims programs. For example, poor nutrition in time many leads to plaque deposits in arteries that cause heart disease, heart attacks, and strokes. We know the medical costs of treating these consequences are high. And the rising costs of renewing medical benefit programs are well known. Both motivate employers to seek ways to contain or reduce the rising costs of supporting medical benefits. Higher deductibles, higher co-pays, reduced benefits, or even elimination of benefits have resulted. In short, employers seek relief from the spiraling costs that directly and immediately affect the cost of doing business. Promising strategies for better management of the costs include motivating employees to improve diet, engage in routine exercise, abstain from smoking, and become educated in monitoring body functions that reflect its health. In short, employees are asked to take responsibility for good health over time that results in fewer and less costly encounters with doctors, hospitals, and others of the health care system.

In some workplace situations employees are called upon to take responsibility for life style choices related to good diet, exercise, and abstinence/moderation where indicated. They are motivated to do so through monetary incentives. One such program is a supplement to existing medical benefits program that reimburses employee outlays for medical care covered by the primary medical plan. See www.benicomp.om. The Benicomp program and

others motivate employees to make life style choices that over time are reflected in improved measures of blood cholesterol, blood pressure, body mass index, and others. Reimbursements to participants are based upon improved measures.

This paper reports a preliminary analysis of body mass index (BMI), systolic blood pressure (BPS), and total cholesterol derived and their relation to annual medical claims. The data resulted from annual tests of employees engaged in the Benicomp Advantage (BA) Program at two northeast Indiana businesses.

DATA

Data was obtained from two companies that offered non-mandatory supplemental benefit coverage that allowed employees to recover as much as \$2,000 in costs (deductible) per year depending on same year lifestyle biometrics (body mass index, blood pressure, total cholesterol, and smoking status). The metrics resulted from annual testing administered by health professionals. They included blood tests. Data was recorded in years 2004 and 2005. Age and gender as well as dollar claims in each year were included in the record.

MODELING THE DATA

The data made available for analysis included what we refer to as 'ideal', that is, there were no missing datum relating to the biometrics of body mass index, blood pressure, total cholesterol, smoking status, age, gender, and dollar claims in years 2004 and 2005.

We investigated the utility of the single equation linear regression model in estimating the relationship among body mass index, blood pressure, total cholesterol, smoking status and annual dollar claims for reimbursement of medical expenses covered by the plan. In this analysis, we dealt with the 'ideal' data set.

Of interest in the early stage of modeling the data was the single equation linear regression model

$$Y_i = b_0 + b_1X_{1i} + \dots + b_kX_{ki} + e_i \quad i=1,\dots,n$$

where Y_i denotes the i th observation of the response variable corresponding to $X_{1i} \dots X_{ki}$, the k values of the associated predictor variables. The e_i is the unobservable error in y_i and b_0, b_1, \dots, b_k are the unknown parameters whose values are sought under the principle of least squares. The $e_i, i=1,\dots,n$, are uncorrelated random variables with expected value zero and unknown common variance S^2 .

Early investigations resulted in best results using log base e of the response variable (annual employee medical claims) and the three biometrics (body mass index, blood pressure systolic, and total cholesterol) as the predictor variables measured in natural units. At this stage, the data set included observations for smokers and nonsmokers. Natural log transformation of the response variable, suppression of the constant (intercept b_0) term, and values of the three predictor variables in natural units produced the following results for the 2004 and 2005 data.

RESULTS

Let

C = annual medical claims filed by employee for reimbursement

BMI = body mass index

BPS = blood pressure systolic

$TCHOL$ = total cholesterol.

In the following displays, the R^2 is the value of the coefficient of determination; $S.E.$ is the standard error; F_{calc} is the calculated F value; and n refers to the number of observations used to fit the model of C on the three predictor variables ($BMI, BPS, AND TCHOL$).

$$\begin{aligned}
 &2004 - \text{Model 1} \\
 C &= 0.0004BMI + 0.0450BPS + 0.0017TCHOL \\
 &\quad (0.2647) \quad (10.2124) \quad (0.6390) \\
 R^2 &= 0.9322 \\
 S.E. &= 1.6932 \\
 F_{calc} &= 513.7609 \\
 n &= 115
 \end{aligned}$$

The value in parentheses is the calculated t statistic for the estimated parameter appearing above it.

Given the statistical insignificance of BMI and $TCHOL$, we investigated the statistical attributes of the simple linear regression model using BPS as the predictor variable. The results follow.

$$\begin{aligned}
 &2004 - \text{Model 2} \\
 C &= 0.0478BPS \\
 &\quad (39.5198) \\
 R^2 &= 0.93197 \\
 S.E. &= 1.6818 \\
 F_{calc} &= 1561.8175 \\
 n &= 115
 \end{aligned}$$

The multiple linear regression model was fitted for the 2005 data and produced the following.

$$\begin{aligned}
 &2005 - \text{Model 1} \\
 C &= 0.0085BMI + 0.0421BPS + 0.0019TCHOL \\
 &\quad (1.1272) \quad (10.1952) \quad (0.7081) \\
 R^2 &= 0.9196 \\
 S.E. &= 1.8194 \\
 F_{calc} &= 1304.2088 \\
 n &= 345
 \end{aligned}$$

Again, given the statistical insignificance of BMI and $TCHOL$ in the 2005 fitted model, we investigated the statistical attributes of the simple linear regression model using BPS as the predictor variable. The results for the 2005 fit follow.

$$\begin{aligned}
 &2005 - \text{Model 2} \\
 C &= 0.0324BPS \\
 &\quad (52.2266) \\
 R^2 &= 0.8880 \\
 S.E. &= 2.1413 \\
 F_{calc} &= 2727.6182 \\
 n &= 345
 \end{aligned}$$

REMARKS

The fitting of the 2004 and 2005 data produced interesting results. For each year, the coefficient of BPS was the only significant parameter estimate. Was found among the results of fitting the multiple and simple linear regression models for each data set (2004, 2005). Further, the coefficient of BPS was relatively the same in each year.

The antilog of the estimate of the coefficients in the multiple linear regression models in each year yielded a value near one (1). This suggests the sum of the three biometrics (body mass index, blood

pressure systolic, and total cholesterol) as a predictor of annual dollar claims.

IMPROVING THE PREDICTOR

We examined the display of claims against the sum of the three biometrics. We noted the variance between the actual and the predictor annual figures for each year's data. We investigated variance reduction technique through segregation of the data within each year. Specifically, for each year's data, we grouped the observations in four parts based upon age, gender, smoking status, and magnitude of annual

medical claims. None of the segregations offered improvements in prediction. We looked to the utility segregation by dollar claims and varying weights given to the sum of the biometrics and age. We will report the results in the March 2007 Meeting of the Midwest Business Administration Association (MBAA) and its Marketing Management Association (MMA).

REFERENCES

None to cite at this time.