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Regression Analysis of Socio-Economic Factors Leading to Increased Body Weight and Obesity in America

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ABSTRACT

Obesity epidemic is known to be one of America's most severe and fastest growing health complications. The continuous increase in the number of overweight individuals and in the obesity rates in the country lead to numerous other significant health consequences and contribute to intensified rates of more than 50 severe diseases. These circumstances furthermore create major pressure on America's health care system. However, it is not exactly clear as to why the prevalence of obesity has increased so dramatically over the last 30 years. This study looks at various socio-economic factors that have been identified as important influences on weight imbalance in the American population: physical activity rates, sugar consumption, availability of physician care, growth of fast food restaurants, lack of sleep, prescription drugs, and alcohol consumption. We identify the main factors related to overweight and obesity rates and perform a statistical analysis to explore the nature of these relationships.

Keywords: obesity, body weight, obesity risk factors, socio-economic factors, America

INTRODUCTION

Obesity is defined as having a body mass index (BMI) of 30 or more, which equals weight in kilograms divided by height in meters squared (Centers for Disease Control and Prevention, 2008). The sudden increase in overweight individuals and the epidemic of obesity in America are currently a major public health fear. Obesity furthermore causes abundant health problems which include but are not limited to diabetes, hypertension, high cholesterol, cardiovascular diseases, asthma, arthritis, and even forms of cancer. In the early 1960s, the average American adult male weighed 168 pounds while today he weighs nearly 180 pounds. Over the same time period, the average female adult weight rose from 143 pounds to over 155 pounds (U.S. Department of Health and Human Services, 2006). While only 15 percent of the population in the 1970's was classified as obese, today the statistics are twice as high (Centers for Disease Control, 2003). Today, Americans are heavier than physicians commend, but the weights continue to increase. Although other countries around the world also have high rates of obesity, there is no country whose statistics surpass the United States. Therefore, the questions are: what does explain the constant growth in obesity in the country? Why is obesity higher in the United States than in any other developed country? In an attempt to combat obesity, the United States government has tried introducing policies to promote healthier diets and partaking in physical activities. Most of these efforts are specifically aimed at younger school-children in order to change their curriculum and include healthy lifestyle education. Other efforts include physician counseling for patients, higher taxes on unhealthy foods, and regulating advertisements. Today, Americans possess more knowledge about their bodies and the consequences of an improper diet, however they are unhealthier and heavier than ever before and the statistics continue to increase. We use 1997-2011-cohort of data from The Organization for Economic

Cooperation and Development (OECD) data, which allows us to compare the prevalence of obesity in the US surveyed roughly at 15 years span.

LITERATURE REVIEW

Countless researchers have sought to determine the underlying causes that could influence increase in obesity rates that began roughly 25 to 30 years. Charles L. Baum and Shin-Yi Chou (2011) simultaneously estimate the effects of the various socio-economic factors on weight status, considering in their analysis the following factors: employment, physical activity at work, food prices, the prevalence of restaurants, cigarette smoking, cigarette prices and taxes, food stamp receipt, and urbanization. Using the traditional Blinder-Oaxaca decomposition technique, the research found that cigarette smoking had the largest effect: the decline in cigarette smoking explains about 2% of the increase in the weight measures. The other significant factors explain less. Philipson and Posner (2001) believe that the major cause of the increase in obesity rates is the technological changes that have taken place recently in the workplace. These technological advances have caused jobs to become more sedentary and therefore individuals have less caloric expenditure. Cutler (2003) suggested increased obesity is also a result of technological changes. Food is easily available in the click of a button from the internet or phone applications. There are less workers employed in manufacturing and mining, which consist of the highest fitness demands. Their research found that spending 18 years in an occupation such as these compared to those with lower fitness demands lowered BMI for males.

Anderson (2003) also stated that changes in the labor force have increased overall obesity. More women have been a part of the labor force recently and as they are mothers, this results from eating away from home. From 1990, mothers in the labor force has increased from 30% to 62% and causes more calorie intake. Rashad and Grossman (2004) believe that the increase in demand of fast-food and calorie-dense food have caused it to become less expensive. They predict increases in the prevalence of restaurants have caused the increase in BMI and note that fast-food restaurants have doubled from 1972-1999. Baum (2011) examined the role of food stamps and found that the food stamp program participation caused an increase in obesity among women with low-incomes. Before the passing of The Food Stamp Act of 1964 as well as other food assistance programs, it was believed that a decrease in food consumption caused poverty. Therefore, the government passed the act in order to help those who suffered from starvation and poverty. However, Baum believes food stamps have increased food consumption because it makes the cost of food zero for eligible individuals.

DATA

The Organization for Economic Cooperation and Development (OECD) harbors worldwide data on a large variety of topics over many years. The purpose of this data is for countries to use it and make notable improvements for their citizens. We use data from the 1997-2011 OECD cohorts to measure the population percentage who fall under the overweight or obese category. Based on the WHO classification, adults with a BMI between 25 and 30 are defined as overweight, and those with a BMI over 30 as obese. For most countries, overweight and obesity rates are self-reported through estimates of height and weight from population-based health interview surveys. However, around one-third of OECD countries derive their estimates from health examinations. The following countries use measured data: Australia, Canada, Chile, the Czech Republic, Finland, Ireland, Japan, Korea, Luxembourg, and Mexico. This study focuses on the United States of America, which uses self-reported estimates. We also used OECD to retrieve data on the physicians that are available as well as the alcohol consumption per capita above 15 years of age.

Data on the growth of fast food restaurants and prescription medication, specifically anti-depressants was received from Statista. Statista offers statistics and survey results in the form of bar charts and tables. The main business model of the platform is offering corporate clients, educators and researchers access to quantitative data. This includes, for example, data on advertising, consumer behavior or separate business fields. These are divided over some 20 industry categories such as E-Commerce & Mail Order Trade, Media & Advertising or Society. Statistics on the percentage of the U.S. population with usage of prescription drugs (anti-depressants) were between 1988 and 2013. Statistics on the number of establishments in the United States fast food industry were available from 1994 to 2013. However, data from 1997-2011 were solely used. Data on lack of sleep and physical activity rates were accessed from the Centers for Disease Control and Prevention, which involved self-reported estimates. The Centers for Disease Control and Prevention (CDC) is the national public health institute of the United States. The CDC focuses national attention on developing, applying disease control and prevention and educational activities designed to improve the health of United States citizens. Finally,

the data on sugar deliveries meant for consumption throughout the United States was retrieved from the United States Department of Agriculture.

METHODOLOGY

Regression analysis was used for the investigation of relationship between the variables and the dependent variable, obesity. We sought to ascertain the casual effect of the variables upon obesity. We also assessed the "statistical significance"of 95% to the estimated relationships, which was the degree of confidence that the true relationship is close to the estimated relationship. Before the outset of the regression study, we formulated a hypothesis on the relationship between the variables of interest, i.e. physical activity, lack of sleep, prescription medicine consumption (anti-depressants), availability of fast food chains, physician availability, alcohol consumption, and sugar consumption. Common knowledge and experience suggested that lower rates of physical activity, growth of fast food chains, and availability of sugary drinks would have a direct relationship to obesity rates in America. Thus, the tentative hypothesis is that an increase in sugary drinks, fast food restaurants, and a decline in physical activity cause obesity. To investigate this hypothesis, we gathered data on the variables and applied regression analysis. We might prove that the null hypothesis is implausible if the t-statistic associated with our regression estimate lies so far out in one tail of its t-distribution that such a valuewould arise less than5 percent of the time

A recent study by Finkelstein researched obesity Forecasts Through 2030. The study presented the estimates of adult obesity through 2013 using nonlinear regression models. The purpose of the research was to reduce healthcare costs on obesity and achieve new obesity prevention efforts. The study was conducted in 2009–2010 and used data from the 1990 through 2008 Behavioral Risk Factor Surveillance System (BRFSS). Future obesity and severe obesity prevalence were estimated through regression modeling by projecting trends in explanatory variables expected to influence obesity prevalence. The study estimates a 33% increase in obesity prevalence and a 130% increase in severe obesity prevalence over the next 2 decades (Finkelstein, 2012).

RESULTS

Factor 1. *Inadequate Sleep*

It is believed that early humans received extra hours of sleep on average compared to current individuals as the rising and setting of the sun synchronized to their circadian rhythms. Increasing evidence from research laboratory studies including animals suggests an automatous link between lack of sleep and increasing body weight. With the study using in rats, sleep deprivation caused an unconscious increase food intake. Furthermore, a study conducted by researchers at the University of Chicago found that the restriction on hours of sleep daily had an impact on the neuroendocrine control of appetite, especially in young lean men. The reduction of sleep caused lessened leptin levels and increased ghrelin levels, which are known as the "hunger hormones". Markedly elevated hunger and appetite ratings were also recorded. The participants of the study were self-reported to find themselves craving particularly sweet and salty appetizers after being deprived of sleep. In addition, analysis of data from a lengthened study from the Wisconsin Sleep Cohort Study showed insignificant sleep length was once again found to be directly linked to reduced leptin levels, high ghrelin levels, and increased BMI. Depriving normal subjects of sleep has been shown to result in insulin responses to hyperglycemia characteristic of insulin resistance and a pre-diabetic metabolic state (Gangwisch, 2005). Individuals who received less than 7 hours of sleep daily were considered as having a shortage of sleep in their life. In 2011, there were 46.8% of individuals in America who self-reported that they did not receive more than 7 hours of sleep. After regression analysis of percentage of Americans who have inadequate sleep and obesity rates, we see that there is an extremely strong influence of lack of sleep on increased overweight and obesity rates. The p-value is 5.1740E-07 and the t stat is 9.6641, which allows us to reject the null hypothesis.

Factor 2. *Growth of Fast Food Restaurants*

In a study published in the Journal of the American Medical Association in 2010, Katherine Flegel and colleagues from the Centers for Disease Control and Prevention report that Americans spend 30 percent of their income overall on fast food. Researchers at the University of California Berkeley found that an individual's nearness to fast food restaurants leads to an increase in their weight. This study was done on ninth grade students and showed that those who were within one-tenth of a mile of a fast food restaurant, had a 5 percent increase in weight. According to the 2010 Dietary Guidelines for Americans, issued by the U.S. Department of Agriculture, healthy adults under the age of 51 should have a limited intake of sodium of about 2,300 mg a day. However, having one meal at a fast food restaurant usually is able to exceed that limit

and contain far more than the dietary guideline's recommendations. Individuals also continue to exceed 2,000 calories per day yet, still visit their local fast food restaurant as it is an easier option. Former Surgeon General David Kessler explains the addictive power of fast food in his book "The End of Overeating." He states that fast food is difficult to resist due to the combinations of sugar, fat and salt which are made to stimulate your appetite. The aromas portraying that the food is fresh work together to overcome thoughts that the fat, salt and sugar in the food are bad for health. All of these factors combine to make the abundance of fast food restaurants an increasing threat to American society's obesity issue. In 1997, there were a total of 201,667 fast food restaurants in America while in 2011, there were a total of 247,191. The numbers continue to grow. Our regression analysis of fast food restaurants and obesity rates, also shows that there is an extremely strong influence from these restaurants on increased overweight and obesity rates. We were not surprised to this finding as we hypothesized fast food restaurants were a major concern.

Factor 3. *Lack of Physical Activity*

It is commonly and universally known that physical activity and forms of exercise provide extreme health benefits and also can help reduce body weight. Data from government funded epidemiological studies have shown that exercise help regulate an important mechanism which improve metabolic activity. Novel mechanisms appear to involve exercise-induced changes in CD14 + CD16 + cell populations, expression of toll-like receptors, and key changes in the metabolic regulation of visceral white adipose tissue (Hamer, 2010). New evidence also suggests that exercise and regular physical activity reduces inflammation in the body and improves glucose control in obesity, independent of weight loss. Supplementary promising research has instead focused on signaling pathways which include the insulin receptor substrate and Akt substrate. Using novel imaging techniques, these studies have demonstrated in the subjects that exercise reduced visceral adipose tissue and liver fat. Daily exercise without caloric restriction was associated with substantial reductions in total fat, abdominal fat, visceral fat, and insulin resistance in women. Exercise without weight loss was also associated with a substantial reduction in total and abdominal obesity (Ross, 2004). In 2011, there were almost 51.1 percent of individuals who do not exercise the suggested amount of 1-2 hours of a day. After regression analysis of percentage of Americans who exercise less than one hour a day and obesity rates, we see that there is a strong influence of lack of exercise on increased overweight and obesity rates. The p value is 1.38E-09 and the t stat is 16.41706, which allows us to reject our null hypothesis. Once again, we are not surprised with this finding as we believed lack of exercise is one of the top reasons for the cause of this nation's growing obesity.

Factor 4. *Prescription Drugs (Anti-Depressants)*

About one in 10 Americans takes antidepressants, according to the Centers for Disease Control and Prevention (CDC). Use of the drugs rose 400 percent over the past two decades, making them the most frequent prescription for Americans ages 18 to 44. A majority of psychiatric medications in the recent market are known to generate weight gain as a side-effect and therefore ultimately cause obesity in some patients. Researchers now have a wide-spread amount of evidence that can link prescription medication to weight gain. Perlis and colleagues conducted an electronic health records analysis to track weight gain among more than 19,000 adults suffering from depression. These patients had been treated with at least one of 11 different antidepressants for at least three months between 1990 and 2011. Roughly 3,400 additional patients were also included in the analysis, although none had been diagnosed with depression. Weight fluctuation among all the patients was followed for one year. Perlis and colleagues found that being younger and/or male increased the risk for gaining weight, as did starting treatment with a relatively low body mass index (BMI, a measurement based on weight and height). Using health records from one New England healthcare system, researchers studied 19,244 adults treated with antidepressants, recording their weights over the course of a year. The results showed that people taking any antidepressants known as selective serotonin reuptake inhibitors, or SSRIs, gained more than two and a half pounds, on average. In 1997, there was only 2.3 percent of the American population that was reported as taking anti-depressants while in 2011, the statistics rose to 7.5 percent. We did not believe that anti-depressants would be a major cause of concern or a valid factor in this study. Regression analysis shows a p value of 0.018714 and a t value of 2.7169. These numbers are not nearly as strong as the other factors have proved to be and therefore we will not reject the null hypothesis. Although anti-depressant use may be a big reason for the increase in weight in numerous individuals, anti-depressants are only used by 7 percent of the population while almost 60 percent is now overweight/obese.

Factor 5. *Sugar Consumption*

Another factor taken into consideration in this study was sugar consumption. As previously stated, the physiological reason for weight gain and obesity is that the body stores the energy that is not used, and sugar, particularly fructose, is a very large source of energy that can be easily consumed. The rise of obesity seems to correlate with the increasing availability of sugar. "For example, obesity was initially seen primarily in the wealthy, who would have been the only ones able to afford sugar. Also, the first documentation of hypertension, diabetes, and obesity occurred in the very countries (England, France, and Germany) where sugar first became available to the public." (Johnson, Segal, et. al., 2014) In this study, we are focusing on the United States, and studies have shown that although diets low in fat have been promoted here, sugar consumption is still prevalent and obesity rates continue to increase. Using data from OECD and the United States Department of Agriculture (USDA) we did a regression analysis between the population percentage of the United States that is overweight or obese and the total sugar deliveries meant for consumption in the country in 1000 short tons. From this analysis we see a p-value of 0.67487 and a t stat value of 0.42911 which indicates that the total sugar deliveries for consumption in the country is not a strong influence on obesity. Because of this weak influence, we decided to focus our attention on a more specific mode of sugar consumption to see if there would be an influence there, sugar-sweetened beverages.

Factor 6. *Sugary Beverages*

Sugar-sweetened beverages (SSBs), including soda, sports drinks, and other types of beverages, are made up primarily of water and added sugar.[1] Americans report that SSBs comprise 6-7% of overall calorie intake(The Obesity Society, 2014). A paper written by Dentist Jay Oltjen, studying the effects of SSBs on tooth decay, tells us that consumption of sugary soft drinks increased by 56% from 1990 to 2000 and that retail sales are over $60 billion annually. That supports the claim that soft drinks are consumed more in the United States than any other beverage available (Oltjen, 2014) The average 12 oz. can of a sugary beverages contains approximately 150 calories from sugar, therefore caloric intake from a soft drink may happen a lot faster than the consumer realizes (Harvard, 2014). For these reasons, we did a regression analysis on sugar-sweetened beverages and overweight or obese people in the United States in particular. Unlike the regression analysis of total sugar deliveries in the United States, the sugar deliveries for consumption of sugar-sweetened beverages shows us a very high correlation. We see a strong influence on overweight and obesity rates from sugary drinks.

Factor 7. *Alcohol Consumption*

Due to the high caloric value and often repetitive intake of alcohol, we chose alcohol consumption as another possible risk factor for increasing overweight and obesity rates. A study done in 2007 by Helmut Schroder et al began off of a similar premise. The National Institute on Alcohol Abuse and Alcoholism (NIH) tells us that the average alcoholic beverage, i.e. a 12 oz. beer, a 1.5 oz. distilled drink, or a 3-5 oz. cocktail or glass of wine, contains about 120 calories. Although this may not seem like much, the danger with calories in alcoholic beverages is that they are not filling, and therefore do not replace caloric intake from another source, and that alcoholic beverages are most often consumed in quantities of more than one. In that same study by Schroder et al, they state "Several studies have identified alcohol consumption as a risk factor for abdominal deposition of fat," (Schroder, 2007) and this study may further support that claim with our results. This regression analysis used the overweight and obesity population percentage data and the alcohol consumption of persons of 15 years of age or older in liters per capita. In the results, we get a t Stat value of 11.8085 and a P-value of 2.5×10^{-8}, indicating that alcohol consumption might have an influence on overweight and obesity rates.

Factor 8. *Physician Availability*

The final factor that we studied was the availability of physicians to the citizens of a country. Obesity is not something that a person is neither born with, nor something they acquire overnight. Becoming overweight or obese is a slow and gradual process. If a person has the ability to visit a physician on a regular basis, say annually, the approach to obesity can be detected and stopped, or prevented. Not to mention that seeing a patient for an extended period of time gives the physician an advantage. It helps the physician get to know more details about the patient that one might not recognize just by looking at a chart or seeing the patient only when they are seriously ill. Details might include the patient's race, ethnicity, hereditary illnesses, habits, career, and exercise patterns, all information that can help the physician determine whether or not the patient might be predisposed to becoming overweight or obese and can therefore lead the physician to better inform the patient of risk factors and prevention. (Chrysallis 2010) From OECD we acquired data on the number of physicians in the U.S.

from 1997 to 2011 and did one final regression analysis. From the t Stat value and P-value numbers, we are able to discern that low physician availability might have a strong influence on overweight and obesity rates increasing. It is unclear if these physicians are all primary care physicians as opposed to a combination of primary care physicians and specialists.

MULTI-REGRESSION ANALYSIS

After conducting a multi-regression analysis of all the factors comparatively to the obesity trends, the results matched extremely similarly to the individual linear regression tests. As a result of the linear regression tests, the three factors that proved to be strong factors of obesity trends in the United States were: fast food consumption, low exercise rates, and physician availability. In a similar sense, once again the t-Stat and P-value for these three factors were closest to our cut-off numbers when the multi-regression analysis was done. Fast food consumption stood out as the strongest factor in both p and t values. Sleep, alcohol, and anti-depressant medication were not significant factors in obesity trends, which is similar to our linear regression tests.

FORECASTING

The Analysis ToolPak in Excel was used to produce forecasting figures on future trends in obesity in America. Three tools for directly forecasting were used —Moving Average, Exponential Smoothing, and Regression. The Forecast function returns the predicted value of the dependent variable (obesity) for the specific value, x, of the independent variable (represented in the data by factors) by using a best fit linear regression to predict y values from x values. Final results show a continuous trend in obesity of about < 0.3-1 % per year until 2018. The final prediction for 2018 shows a percentage of 67.93% of the American population as overweight or obese.

CONCLUSION

Data from different sources were analyzed to identify the factors that lead to a high body mass index and indicate that a person is either overweight or obese.Our main source of statistical data was the Organization for Economic Cooperation and Development (OECD), which provided us with the percentages of overweight or obese people of the total American population, the alcoholic liters consumed per capita over the age of 15, and the head count of physicians in the United States, from the 1997 to 2011. Other sources of data included Statista, the United States Department of Agriculture, and the Centers for Disease Control and Prevention. Using these data we performed statistical regression analyses to verify or discover the influence of certain factors on the increase of overweight and obesity rates. Those factors were: physical activity, lack of sleep, antidepressant medicine consumption, fast food consumption, physician availability, alcohol consumption, sugar available for consumption and sugar-sweetened beverages.

The only factor for which we did not see an influence on overweight and obesity rates was the extensive use of sugar in the food processing industry. However, when focusing on the use of sugar in the production of sugary beverages, we saw a strong influence.We also discovered that lack of sleep, low physician availability to citizens, and alcohol consumption, have a strong influence on heightened overweight and obesity rates, while confirming that lack of exercise and fast food consumption have a significant influence as well. The factor that seemed to play a minor role in the increase of overweight and obesity rates was the consumption of prescribed antidepressants. However, further investigation comparing people taking the antidepressants versus people not taking antidepressants would be needed. In conclusion, we believe this study might help make people aware of the factors that lead to obesity and contribute to fighting the obesity epidemic.

APPENDIX

I - Linear Regression Results for Factors

Inadequate Sleep

Regression Statistics	
Multiple R	0.9414
R Square	0.8861
Adj. R Squ.	0.8767
Std. Error	0.8210
Observations	14

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	62.94457	62.94457	93.39455	5.1740E-07
Residual	12	8.08757	0.67396		
Total	13	71.03214			

	Coeffi-cients	*Std. Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	41.6051	1.9506	21.3299	6.5695E-11	37.3552	45.8549
Sleep	0.4475	0.0463	9.6641	5.1740E-07	0.3466	0.5484

Growth of Fast Food Restaurants

Regression Statistics	
Multiple R	0.97907
R Square	0.95858
Adj. R Squ.	0.95540
Std. Error	0.55765
Observations	15

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	93.56137	93.56137	300.8681	2.27165E-10
Residual	13	4.042628	0.310971		
Total	14	97.604			

	Coefficients	*Std. Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	18.288095	2.40792	7.594986	3.93E-06	13.08611	23.49008
Fast-food	0.0001845	1.06E-05	17.34555	2.27E-10	0.000162	0.00021

Lack of Physical Activity

Regression Statistics	
Multiple R	0.97846
R Square	0.95737
Adj. R Squ.	0.95382
Std. Error	0.50231
Observations	14

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	68.00434	68.00434	269.5198	1.37858E-09
Residual	12	3.0278	0.252317		
Total	13	71.03214			

	Coefficients	*Std. Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	51.32625	0.56497	90.84793	2.11E-18	50.09528	52.55721
Exercise	0.23642	0.01440	16.41706	1.38E-09	0.20505	0.26780

Prescription Drugs

Regression Statistics	
Multiple R	0.61714
R Square	0.38086
Adj. R Squ.	0.32926
Std. Error	1.91440
Observations	14

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	27.05312	27.05312	7.381641	0.018714273
Residual	12	43.97903	3.664919		
Total	13	71.03214			

	Coefficients	*Std. Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	53.0862	2.7169	19.5391	1.83E-10	47.16650	59.005802
Antidepressants	1.3514	0.4974	2.7169	0.018714	0.267664	2.435234

Sugar Consumption

Regression Statistics	
Multiple R	0.3730396
R Square	0.13916
Adj. R Squ.	0.07294
Std. Error	2.54228
Observations	15

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	13.58243	13.58243	2.10150	0.1708480
Residual	13	84.02157	6.463198		
Total	14	97.604			

	Coefficients	*Std. Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	13.7016	31.9304	0.42911	0.67487	-55.279860	82.683136
Total sugar	0.00497	0.00343	1.44966	0.170848	-0.002436	0.012372

Sugary Beverages

Regression Statistics	
Multiple R	0.89140
R Square	0.79460
Adj. R Squ.	0.77880
Std. Error	1.24183
Observations	15

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	77.55605	77.55605	50.29087	8.15E-06
Residual	13	20.04795	1.54215		
Total	14	97.60400			

	Coefficients	*Std. Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	53.52653	0.96485	55.47649	7.81E-17	51.44210	55.61097
Beverages	0.02569	0.00362	7.09161	8.15E-06	0.01786	0.03351

Alcohol Consumption

Regression Statistics	
Multiple R	0.956410
R Square	0.91472
Adj. R Squ.	0.90816
Std. Error	0.80017
Observations	15

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	89.2804	89.2804	139.4406	2.53393E-08
Residual	13	8.3236	0.6403		
Total	14	97.604			

	Coeffi-cients	*Std. Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	-41.59892	8.60467	-4.83446	0.000326	-60.188181	-23.00966
Alcohol Cons.	12.0259179	1.01841	11.8085	2.53E-08	9.82577	14.22606

Physician Availability

Regression Statistics	
Multiple R	0.97854
R Square	0.95753
Adj. R Squ.	0.95427
Std. Error	0.56466
Observations	15

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	93.4591	93.4591	293.1255	2.67335E-10
Residual	13	4.1449	0.3188		
Total	14	97.604			

	Coeffi-cients	*Std. Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	24.309604	2.08854	11.63955	3.01E-08	19.79760	28.82161
Number of physicians	5.127E-05	2.99E-06	17.12091	2.67E-10	4.48022E-05	5.7741E-05

II –Multi-Regression Analysis Result

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.9897196
R Square	0.9795449
Adjusted R Square	0.9590898
Standard Error	0.5340544
Observations	15

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	7	95.60750098	13.6582	47.8876	2.19E-05
Residual	7	1.996499017	0.28521		
Total	14	97.604			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Obesity	33.807146	48.63021776	0.69519	0.50935	-81.185046	148.79934	-81.185046	148.799339
Alcohol	-2.649E-05	0.00012236	-0.21647	0.83479	-0.0003158	0.0002628	-0.0003158	0.00026285
Sleep	-0.0394214	0.277870747	-0.14187	0.89118	-0.6964813	0.6176385	-0.6964813	0.61763851
Physicians	0.1301715	0.201527667	0.64592	0.53892	-0.3463658	0.6067087	-0.3463658	0.60670866
Fast Food	0.3645159	0.297074354	1.22702	0.25948	-0.3379533	1.0669851	-0.3379533	1.06698513
No Exercise	2.8406219	4.037426425	0.70357	0.50442	-6.7063745	12.387618	-6.7063745	12.3876184
Anti-Depress	-4.468E-06	4.84873E-05	-0.09216	0.92915	-0.0001191	0.0001102	-0.0001191	0.00011019
Beverages	4.688E-06	8.27112E-06	0.56685	0.58852	-1.487E-05	2.425E-05	-1.487E-05	2.4247E-05

III –Forecasting Result

		aka Yt			y2/cma		yt/st		
t	Years	Obesity	MA(AVG)	CMA	St, It	st	Deseason	Trend	Forecast
1	97	55				1.0043	54.76451	55.6132	55.85233
2	98	56.2				1.0056	55.88703	56.18583	56.50047
3	99	57.4	56.2	56.61667	1.0138	1.0081	56.9388	56.75846	57.2182
4	0	57.5	57.03333	57.48333	1.0003	1.0043	57.25381	57.33109	57.57761
5	1	58.9	57.93333	58.25	1.0112	1.0056	58.572	57.90372	58.22798
6	2	59.3	58.56667	58.93333	1.0062	1.0081	58.82353	58.47635	58.95001
7	3	59.7	59.3	59.45	1.0042	1.0043	59.44439	59.04898	59.30289
8	4	59.8	59.6	59.83333	0.9994	1.0056	59.46698	59.62161	59.95549
9	5	60.7	60.06667	60.28333	1.0069	1.0081	60.21228	60.19424	60.68182
10	6	61	60.5	60.85	1.0025	1.0043	60.73882	60.76687	61.02817
11	7	61.9	61.2	61.51667	1.0062	1.0056	61.55529	61.3395	61.68301
12	8	62.6	61.83333	62.25	1.0056	1.0081	62.09701	61.91214	62.41362
13	9	63.5	62.66667	62.86667	1.0101	1.0043	63.22812	62.48477	62.75345
14	10	63.1	63.06667			1.0056	62.74861	63.0574	63.41052
15	11	63.1				1.0081	62.593	63.63003	64.14543
16	12					1.0043		64.20266	64.47873
17	13					1.0056		64.77529	65.13803
18	14					1.0081		65.34792	65.87724
19	15					1.0043		65.92055	66.20401
20	16					1.0056		66.49318	66.86554
21	17					1.0081		67.06581	67.60905
22	18					1.0043		67.63844	67.92929

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