

# Effect of Alcohol on Body Temperature Using Analysis Of Variance (ANOVA)

Oladimeji O. A.<sup>(1)\*</sup>, Ogunbanwo T. A.<sup>(2)</sup>, Oluborode K. O.<sup>(3)</sup>, and  
Oyejide O. T.<sup>(4)</sup>

<sup>1</sup>Department of Statistics, Federal Polytechnic, Ile-Oluji, Ondo State, Nigeria

<sup>2</sup>Department of Mathematics and Statistics, Osun State College of Technology, Esa-Oke, Osun State, Nigeria

<sup>3</sup>Department of Computer Science, Osun State College of Technology, Esa-Oke, Osun State, Nigeria

<sup>4</sup>Global School of Science, Iyana Church, Ibadan, Oyo State, Nigeria

\*Corresponding Author: adedipupo.oladimeji@gmail.com

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## ABSTRACT

This research was carried out on the effect of alcohol on the body temperature of human being using rabbit as a case study. Three types of alcohol (Regal, Seaman, Squadron) were used on three rabbits at recorded period and the methodology used are Analysis of Variance and T-distribution for comparison. Using Analysis of Variance it was observed that the effect of alcohol on body temperature was not significant (i.e.  $\alpha = 0.05 < p = 0.619$ ). From the T-test for equality of means when comparing Regal and Squadron, we conclude that there is no difference in their effect on body temperature within the given period.

**Keywords:** Alcohol, Temperature, Ingredient, Health, Beverage, Consumption, Factors

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## I. INTRODUCTION

### BACKGROUND OF THE STUDY

For over 10,000 years ago, human beings have been drinking fermented beverages, they've also been arguing about their merits and demerits. The debate still abounds today, with a lively back-and-forth over whether alcohol is good or bad. It's safe to say that alcohol is both a tonic and a poison. The difference lies mostly in the dose. Moderate drinking seems to be good for the heart and circulatory system, and probably protects against type 2 diabetes and gallstones. Heavy drinking is a major cause of preventable death in most countries. In the U.S., alcohol is implicated in about half of fatal traffic accidents. Heavy drinking can damage the liver and heart, harm an unborn child, increase the chances of developing breast and some other cancers, contribute to depression and violence, and interfere with relationships among other things.

Alcohol's two-faced nature shouldn't come as a surprise. The active ingredient in alcoholic beverages, a simple molecule called ethanol, affects the body in many different ways. It directly influences the stomach, brain, heart, gallbladder, and liver. It affects levels of lipids (cholesterol and triglycerides) and insulin in the blood, as well as inflammation and coagulation. It also alters mood, concentration, and coordination. Loose use of the terms "moderate" and "a drink" has fueled some of the ongoing debate about alcohol's impact on health. In some studies, the term "moderate drinking" refers to less than 1 drink per day, while in others it means 3-4 drinks per day. Exactly what constitutes "a drink" is also fairly fluid. In fact, even among alcohol researchers, there's no universally accepted standard drink definition.

In the U.S., one (1) drink is usually considered to be 12 ounces of beer, 5 ounces of wine, or 1½ ounces of spirits (hard liquor such as gin or whiskey). Each delivers about 12 to 14 grams of alcohol on average, but there is a wider range now that microbrews and wine are being produced with higher alcohol content. Some experts have suggested that red wine makes the difference, but other research suggests that beverage choice appears to have little effect on cardiovascular benefit.

The definition of moderate drinking is something of a balancing act. Moderate drinking sits at the point at which the health benefits of alcohol clearly outweigh the risks. The latest consensus places this point at no more than 1-2 drinks a day for men, and no more than 1 drink a day for women. This is the definition used by the U.S. Department of Agriculture and the Dietary Guidelines for Americans (2015-2020), and is widely used in the United States.

In 2014, about 61 million Americans were classified as binge alcohol users (5 or more drinks on the same occasion at least once a month) and 16 million as heavy alcohol users (5 or more drinks on the same occasion on 5 or more days in one month). Alcohol plays a role in one in three cases of violent crime.

In 2015, more than 10,000 people died in automobile accidents in which alcohol was involved. Alcohol abuse costs about \$249 billion a year. Even moderate drinking carries some risks. Alcohol can disrupt sleep and one's better judgment. Alcohol interacts in potentially dangerous ways with a variety of medications, including acetaminophen, antidepressants, anticonvulsants, painkillers, and sedatives. It is also addictive, especially for people with a family history of alcoholism.

Alcohol Increases Risk of Developing Breast Cancer. There is convincing evidence that alcohol consumption increases the risk of breast cancer, and the more alcohol consumed, the greater the risk. A large prospective study following 88,084 women and 47,881 men for 30 years found that even 1 drink a day increased the risk of alcohol-related cancers (colorectum, female breast, oral cavity, pharynx, larynx, liver, esophagus) in women, but mainly breast cancer, among both smokers and nonsmokers. 1 to 2 drinks a day in men who did not smoke was not associated with an increased risk of alcohol-related cancers.

In a combined analysis of six large prospective studies involving more than 320,000 women, researchers found that having 2-5 drinks a day compared with no drinks increased the chances of developing breast cancer as high as 41%. It did not matter whether the form of alcohol was wine, beer, or hard liquor. This doesn't mean that 40% or so of women who have 2-5 drinks a day will get breast cancer. Instead, it is the difference between about 13 of every 100 women developing breast cancer during their lifetime—the current average risk in the U.S.—and 17 to 18 of every 100 women developing the disease. This modest increase would translate to significantly more women with breast cancer each year.

A lack of folate in the diet or folic acid, its supplement form, further increases the risk of breast cancer in women. Folate is needed to produce new cells and to prevent changes in DNA. Folate deficiency, as can occur with heavy alcohol use, can cause changes in genes that may lead to cancer. Alcohol also increases estrogen levels, which fuel the growth of certain breast cancer cells. An adequate intake of folate, at least 400 micrograms a day, when taking at least 1 drink of alcohol daily appears to lessen this increased risk.

Researchers found a strong association among three factors—genetics, folate intake, and alcohol—in a cohort from the Nurses' Health Study II of 2866 young women with an average age of 36 who were diagnosed with invasive breast cancer. Those with a family history of breast cancer who drank 10 grams or more of alcoholic beverages daily (equivalent to 1 or more drinks) and ate less than 400 micrograms of folate daily almost doubled their risk (1.8 times) of developing the cancer. Women who drank this amount of alcohol but did not have a family history of breast cancer and ate at least 400 micrograms of folate daily did not have an increased breast cancer risk.

People who drink heavily may develop a physical and emotional dependency on alcohol. Alcohol withdrawal can be difficult and life-threatening. You often need professional help to break an alcohol addiction. As a result, many people seek medical detoxification to get sober. It's the safest way to ensure you break the physical addiction. Depending on the risk for withdrawal symptoms, detoxification can be managed on either an outpatient or inpatient basis. Alcohol's impact on your body starts from the moment you take your first sip. While an occasional glass of wine with dinner isn't a cause for concern, the cumulative effects of drinking wine, beer, or spirits can take its toll. Drinking too much alcohol can cause abnormal activation of digestive enzymes produced by the pancreas. Buildup of these enzymes can lead to inflammation known as pancreatitis. Pancreatitis can become a long-term condition and cause serious complications. Thirty seconds after your first sip, alcohol races into your brain. It slows down the chemicals and pathways that your brain cells use to send messages. That alters your mood, slows your reflexes, and throws off your balance. You also can't think straight, which you may not recall later, because you'll struggle to store things in long-term memory. Drinking of alcohol heavily for a long time, booze can affect how your brain looks and works. Its cells start to change and even get smaller. Too much alcohol can actually shrink your brain. And that'll have big effects on your ability to think, learn, and remember things. It can also make it harder to keep a steady body temperature and control your movements.

## **II. AIM AND OBJECTIVES OF THE STUDY**

The aim of this research is to check the effect of different kinds of alcohol on body temperature with the following objectives.

1. to determine the brand of alcohol that contributes significantly to the rejection of the null hypothesis.
2. to conduct a post hoc test when null hypothesis is rejected.
3. to examine the effect of the block (Rabbit 1, Rabbit2 & Rabbit 3) to conduct analysis
4. comparing the effect of Regal & Squadron on the human body temperature.

## **SCOPE OF THE STUDY**

The scope of this study covers an experimental designed to know the effect of three different concentration of Alcohols (Regal @ 43%, Seaman @ 40% and Squadron @ 42% ) on body temperature using three different Rabbits as our factors.

## **HYPOTHESIS STATEMENT**

### **Hypothesis one**

H<sub>0</sub>: The effect of alcohol on body temperature is not significant

H<sub>1</sub>: The effect of alcohol on body temperature is significant

### **Hypothesis two**

H<sub>0</sub>: There is no difference between the treatments means

H<sub>1</sub>: There is significant difference between the treatment means.

## **III. REVIEW OF RELATED LITERATURES**

The 1978 update briefly discussed the elementary aspects of how the body processes alcohol. No significant changes in our understanding of the fundamentals of these processes have occurred since then, although significant new knowledge of interest to specialists has been gained.

Processing of alcohol by the body begins with absorption by the stomach and small intestines, a process that generally requires some one to three hours, depending on the type and quantity of the alcoholic beverage, and the presence of food in the stomach. Alcohol enters the bloodstream by simple diffusion, and does not have to be digested. The presence of food in the stomach slows the rate of alcohol absorption, but absorption is also influenced by other factors including the type of alcoholic beverage, the drinker's gender, body temperature, the presence of certain medications in the body, and the types of spices in the food. Distribution to various parts of the body then occurs.

Body fat and skeletal mass absorb very little alcohol. Thus, an identical quantity of alcohol per unit of body weight will induce a higher BAC in women than in men because of differences in body constitution (Bode and Bode, 1997). Some recent research suggests that, in a social drinking setting, a shorter time to peak *Blood Alcohol Concentration* (BAC) and a faster absorption rate may occur when alcohol is consumed over an extended period. In contrast, earlier studies found longer absorption times Winek, Wahba, and Dowdell, (1996).

The variability of absorption time is illustrated by a study by Friel, Baer, and Logan (1995). The study examined alcohol disposition in 77 female and 97 male college seniors who were regular drinkers who exceeded legal intoxication levels at least twice a month by history. After receiving a standard alcohol dose (lower for females than for males) over 10 minutes, after a four-hour fast, breath alcohol concentrations (BrACs) were measured for two hours. The time to peak BrAC varied from 10 to 91 minutes after the start of drinking, and mean BrACs were significantly lower in females than in males.

Absorption and peak BAC vary by type of food as well as amount of food. For example, a study of a small sample of women subjects found that the peak BAC was significantly higher in those drinking alcohol and sodium (simulating salty food) than in those drinking alcohol with no sodium (Talbot and La Grange, 1999). Alcohol is metabolized primarily in the liver, but metabolism occurs also in the stomach and small intestine. Gastric alcohol metabolism, which is significant only at low alcohol concentrations, is more efficient in men than in women, which helps explain why the same amount of alcohol produces higher blood alcohol concentrations in women than in men. There is also evidence that alcohol can be metabolized by bacteria in the large intestine. Bode and Bode (1997) note that alcohol is not only degraded, but also produced in the gastrointestinal tract as a by-product of bacterial breakdown of ingested carbohydrates.

Finally, of the alcohol absorbed, 90-98 % is oxidized, 1-5 % is excreted in an unaltered state in urine, and another 1-5 % is expired via the lungs Vrij-Standhardt, (1991). The total time to eliminate alcohol from the body is dependent upon the variables that influence absorption (see above)

## **MEASUREMENT OF ALCOHOL PRESENCE**

Since alcohol's immediate effects are due to its effect on the brain, it would be desirable to know the alcohol concentration in the brain after drinking. Obviously, direct measurements are impractical for most purposes, and other means must be used for estimating "brain-alcohol concentration." Chemical tests of blood drawn from a vein or capillary are the preferred indirect way of estimating alcohol concentration in the brain in live humans. Other chemical tests that relate alcohol presence elsewhere in the body to alcohol presence in the blood, have also been used, the most common now being tests of alcohol in air expired from the lungs.

Breath-alcohol measurement has become more precise and reliable since the 1978 update, and also more convenient and easy to perform, especially in forensic settings. The 1978 update noted that the factor (estimated at 2,100 at that time) for converting breath alcohol measurements to blood alcohol measurements could not be precisely determined, and also presented data from 28 studies on the blood/breath deviation. The data indicated that breath testers typically underestimated BAC by up to 10% or so.

More recent studies using improved technology indicate that the conversion factor may be closer to 2,400 than 2,100, (Jones and Anderson, 1996). This means that, on average, using a conversion factor of 2,100 would underestimate BAC by about 10%. Jones and Anderson note the fairly high variability of the conversion factor and discuss some of the factors that may influence the variability. Jones and Pounder (1998) discuss

current practices for measuring alcohol concentration in clinical and forensic laboratories and recommend methods for assuring quality in laboratory procedures.

Hart, Smith, Hole et al. (1999) studied the relationship between alcohol consumption and mortality from all causes of 5,766 Scottish men, aged 35-64. The subjects entered the study in 1970-1973 and were followed for 21 years. The study found a similar relative risk for all-cause mortality for nondrinkers and for those drinking up to 14 units a week; and increasing risk with consumption, amounting to 1.34 for 15-21 units a week, 1.49 for 22-34 units, and 1.74 for 35 or more units. The authors concluded that "the overall association between alcohol consumption and mortality is unfavorable for those drinking more than 22 units a week," and that "there is no evidence for any protective effect at any level of consumption."

Of foremost concern has been the effects of alcohol on the liver which bears the major burden in metabolizing alcohol. Liver cirrhosis (a degeneration of liver tissue, resulting in fibrosis and nodule formation) has received particular attention. The path toward cirrhosis starts within the liver as inflammation (hepatitis), and progresses to fatty liver, and cirrhosis. The epidemiology of cirrhosis is complicated by the fact that heavy drinking is not its only cause, and that not all heavy drinkers develop cirrhosis. Other conditions that lead to cirrhosis include viral hepatitis, inherited diseases, diseases of the bile duct, and diseases of the blood. While it has been estimated that the incidence of cirrhosis is 3 out of 10,000 people, only about 10% to 15% of alcoholics have cirrhosis at the time of death.

DeBakey, Stinson, Grant et al. (1995) estimated that, during 1970 - 1992, age-adjusted death rates from alcohol-related liver cirrhosis dropped by 24.1% (5.4 deaths per 100,000 in 1970 to 4.1 deaths per 100,000 in 1992). An analysis of the relationships between cirrhosis mortality and per capita consumption of distilled spirits in the United States in the years from 1949-1994 found that there is a consistent long-term trend relationship between mortality from cirrhosis and per capita consumption of distilled spirits, but could not establish a direct causal link between consumption of distilled spirits and long-term cirrhosis mortality Roizen, Kerr, and Fillmore, (1999). Kernochan and Yee (1999) even suggest that societal changes could be partially responsible for the development of serious liver disease in populations, and that spirits consumption may serve as marker for some societal event that occurred many years earlier and affected cirrhosis mortality. The effects of alcohol consumption on the risk of various types of cancers has also been studied extensively. A meta-analysis of 123 studies found not only higher risks for cirrhosis, but also "weaker but significant" relationships for colorectum, liver, and breast cancers Corrao, Bagnardi, Zamboni et al., (1999). The authors found that: "For all these conditions, low intakes, corresponding to daily consumption of two drinks or two glasses of wine (25 g/day), have shown significant risks." The authors concluded:

"The small number of sufficiently reliable studies, the strong indications of heterogeneity across them, and the suspicion of publication bias suggest a great need for well-conducted epidemiological studies in several countries to examine the dose-response relationship between alcohol intake/drinking pattern and the risk of several alcohol-related conditions."

Also, an extensive recent study on carcinogens in general (U.S. Department of Health and Human Services, 2000a) concluded that "consumption of alcoholic beverages is known to be a human carcinogen based on sufficient evidence of carcinogenicity from human studies that indicate a causal relationship between consumption of alcoholic beverages and cancer in humans," and, specifically, that:

"Consumption of alcoholic beverages is causally related to cancers of the mouth, pharynx, larynx, and esophagus. Cohort and case control studies in a variety of human populations are notable for their consistency in reporting the presence of moderate to strong associations with dose-response relationships for these four sites. Evidence also supports a weaker but possibly causal relation between alcoholic beverage consumption and increased risk of cancers of the liver and breast."

#### **IV. METHODOLOGY**

The methodology may be considered as a systematic and scientific process of gathering, recording and analyzing data about problems and issues relating to human existence on earth. There are several statistical tools in the analysis of statistical data, each of which has its own application, but the one used in this research is F-test (ANOVA) for two way classifications.

#### **SOURCES OF DATA**

The source of data used is primary data through the use of experiment. An experimental design carried out to know the effect of three different types of Alcohols (Regal @ 43%, Seaman @ 40% and Squadron @ 42% ) on the body temperature using three different Rabbits.

#### **MODEL OF RANDOMIZED COMPLETE BLOCK DESIGN (RCBD)**

To every design of experiment (DOE), there must be model, but that for Randomized Complete Block Design (RCBD) is as below:

$$Y_{ij} = \mu + \tau_i + \beta_j + e_{ij}$$

Where:  $\tau_i$  is the effect of treatment 'i'.

$Y_{ij}$  is the observation in block 'j' receiving treatment 'i'

$\mu$  is the overall mean/grand mean.

$\beta_j$  is the effect of block 'j'.

$e_{ij}$  is the random error which is assumed to be independently and normally distributed with mean zero and constant variance i.e.  $e_{ij} \sim N(0, \sigma^2)$

**PARTITIONING OF SUM OF SQUARES**

In statistics, the sum of squares is a measure of the total variability (spread, variation) within a data set. In other words, the sum of squares is a measure of deviation or variation from mean value of the given data set.

The partitioning of the sum of squares is otherwise called partitioning of variance. It is the process of separating the sum of squares into parts. Below is the partitioning of the sum of squares for the randomized complete block design (RCBD).

$$\Sigma(Y_{ij} - \bar{Y}_{..})^2 = \Sigma[(\bar{Y}_i - \bar{Y}_{..})^2 + (\bar{Y}_j - \bar{Y}_{..})^2 + (Y_{ij} - \bar{Y}_i - \bar{Y}_j + \bar{Y}_{..})^2]$$

$$= b\Sigma(\bar{Y}_i - \bar{Y}_{..})^2 + t\Sigma(\bar{Y}_j - \bar{Y}_{..})^2 + \Sigma(Y_{ij} - \bar{Y}_i - \bar{Y}_j + \bar{Y}_{..})^2 + \text{cross product, which is assumed to be zero}$$

Where:  $\Sigma(Y_{ij} - \bar{Y}_{..})^2$  is the total variation/ sum of squares of total

$b\Sigma(\bar{Y}_i - \bar{Y}_{..})^2$  is the sum of squares of treatment

$t\Sigma(\bar{Y}_j - \bar{Y}_{..})^2$  is the sum of squares of block; and

$\Sigma(Y_{ij} - \bar{Y}_i - \bar{Y}_j + \bar{Y}_{..})^2$  is the sum of squares of error

The above sum of squares can be written as:

$$SS_T = \Sigma Y_{ij}^2 - \frac{Y^2}{bt}$$

$$SS_b = \frac{\Sigma Y_j^2}{t} - \frac{Y^2}{bt}$$

$$SS_t = \frac{\Sigma Y_i^2}{b} - \frac{Y^2}{bt}$$

$$SS_E = SS_T - SS_t - SS_b$$

Where:

$SS_T$  is the sum of squares of Total

$SS_t$  is the sum of squares of treatments

$SS_b$  is the sum of squares of blocks

$SS_E$  is the sum of squares of Error/ residual sum of square

b is the number of blocks

t is the number of treatments

bt is the total number of observations

$Y_i$  Is the treatment total/ row total

$Y_j$  is the block total/ column total; and

$Y_{..}$  is the overall/grand total

**V. ANALYSIS**

TABLE1: Regal

Temperature	Rabbit1	Rabbit2	Rabbit3
10	38.6	35.4	38.9
20	38.7	34.7	38.5
30	37.7	34.2	37.6
40	37.6	35.0	37.5
50	37.6	38.2	38.4
60	37.6	37.7	38.4

TABLE2: Seaman

Temperature	Rabbit1	Rabbit2	Rabbit3
10	38.4	35.4	38.1
20	38.1	38.6	39.0
30	38.1	37.6	39.2
40	37.9	37.6	38.6

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50	37.6	34.4	38.4
60	38.3	37.2	38.0

**TABLE3: Squadron**

Temperature	Rabbit1	Rabbit2	Rabbit3
10	38.8	38.7	38.0
20	38.8	38.3	37.7
30	38.3	37.5	37.7
40	37.3	37.5	37.6
50	37.8	37.5	37.0
60	37.8	37.5	37.0

Table 4. showing the average means of data collected on effect of alcohol in body temperature. Where T<sub>1</sub> is Regal, T<sub>2</sub> is Seaman and T<sub>3</sub> is Squadron. Also B<sub>1</sub>, B<sub>2</sub> and B<sub>3</sub> are Rabbits.

	B <sub>1</sub>	B <sub>2</sub>	B <sub>3</sub>
T <sub>1</sub>	37.97	35.87	38.22
T <sub>2</sub>	38.07	37.17	38.55
T <sub>3</sub>	38.10	37.88	37.50

**Tests of Between-Subjects Effects**

Dependent Variable: RESPONSE

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
RABBIT Hypothesis	2.401	2	1.200	2.290	.217
RABBIT Error	2.097	4	.524 <sup>a</sup>		
ALCOHOL Hypothesis	.567	2	.284	.541	.619
ALCOHOL Error	2.097	4	.524 <sup>a</sup>		
RABBIT * ALCOHOL Hypothesis	2.097	4	.524		
RABBIT * ALCOHOL Error	.000	0	<sup>b</sup>		

a. MS(RABBIT \* ALCOHOL)

b. MS(Error)

Hypothesis Statement

H<sub>0</sub> : the effect of alcohol on body temperature is not significance

H<sub>1</sub> : the effect of alcohol on body temperature is significance

Level of significance

At  $\alpha = 0.05$

Test statistic

ANOVA (F-test)

Decision rule/ critical region

Reject H<sub>0</sub> if P-value < 0.05

Decision and conclusion

Since P-value of the two factors are greater than 0.05, we do not have sufficient reason to reject null hypothesis.

We therefore we conclude that effect of alcohol on body temperature is not significant.

**Group Statistics**

	ALCOHOL	N	Mean	Std. Deviation	Std. Error Mean
RABBIT	REGAL	18	2.00	.840	.198
	SQUADRON	18	2.00	.840	.198
PERIOD	REGAL	18	3.50	1.757	.414
	SQUADRON	18	3.50	1.757	.414
RESPONSE	REGAL	18	37.3500	1.47179	.34691
	SQUADRON	18	37.8444	.71884	.16943

independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
RABBIT	Equal variances assumed	.000	1.000	.000	34	1.000	.000	.280	-.569	.569
	Equal variances not assumed			.000	34.000	1.000	.000	.280	-.569	.569
PERIOD	Equal variances assumed	.000	1.000	.000	34	1.000	.000	.586	-1.190	1.190
	Equal variances not assumed			.000	34.000	1.000	.000	.586	-1.190	1.190
RESPONSE	Equal variances assumed	5.904	.021	1.281	34	.209	-.49444	.38607	-1.27903	.29015
	Equal variances not assumed			1.281	24.674	.212	-.49444	.38607	-1.29010	.30122

**Interpretation1:** From the levene's test of equality of variances when comparing Regal and Squadron, we conclude that only by response fails the test since its P-value < 0.05

**Interpretation2:** From the t-test for equality of means when comparing Regal and Squadron, we conclude that there is no difference in their mean by rabbit, period and response accordingly since P-value(s) > 0.05

**VI. SUMMARY**

This research topic titled effect of alcohol on human body temperature; aimed at measuring the response effect of treatment (alcohol used) 10mins interval until 1hour on human body temperature. The treatment are regal, seaman and squadron which are applying to measure their response effects individually. The analysis of variance and the regular independent sample t-test would be employed accordingly. The treatment applied is in three different bodies. The levene's test of equality of variance checked to satisfy the assumption homogeneity of variance.

**VII. CONCLUSION**

Based on the result carried out, it was observed that the effect of alcohol on body temperature is not significant using analysis of variance (i.e  $\alpha = 0.05 < p = 0.619$ ) and from the t-test for equality of means when comparing Regal and Squadron, we conclude that there is no difference in their mean by rabbit, period and response accordingly since P-value(s) > 0.05 therefore the effect of regal and squadron is the same.

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