Background: Need to examine the efficacy of 4 psychosocial treatments (1=IDC, 2=CT, 3=SE, 4=GDC) for cocaine dependent patients.

Also need to perform the sub hypothesis which includes the two way and the three-way interactions.

Method: 487 patients were randomly assigned to the 4 treatment arms and were observed for 6 months. We need to perform the cross-sectional analysis at Month 3 and Month 6.

Goal: Does treatment predict the outcome (SIGHD17) at month 3 and month 6 and we need to compare results for both months.

Also, we need to check the significance of the two way and the three way interactions included in the sub hypothesis.

**Outcome Variable: SIGHD17**

One of the most frequently used instruments for evaluating depression in adults, the questionnaire allows clinicians to assess the nature and severity of mood disorders in patient populations.

Each question examines a different symptom or aspect of depression, including mood, guilty feelings, suicidal ideation, insomnia, agitation, and somatic symptoms.

Each of the behaviorally anchored items is rated on either a 3- or 5-point scale and summed to obtain the total score. Scores greater than 24 are indicative of severe depression, and scores less than 7 are indicative of the absence of depression.

Reading of the Hamilton Depression Scale

The patient will be identified, and the depression level in the patients will be measure by the scales, and the results of reading during the following ranges will tell the story of depression in the patient:

1. No Depression (Zero to Seven)

2. Mild Depression (Eight to Sixteen)

3. Moderate Depression (Seventeen to Twenty-two)

## 4. Severe Depression (Greater than twenty-four)

Interpretation: Higher the score, Higher the depression.

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* Outcome Variable Significance:

The patient are identified, and the depression level in the patients is measured on either a 3- or 5-point scale on the basis of several components like Depressed mood, feeling of guilt, Suicide, Insomnia etc. Each summed to obtain the total score and the results of reading during the following ranges will tell the story of depression in the patient:

1. No Depression (Zero to Seven)

2. Mild Depression (Eight to Sixteen)

3. Moderate Depression (Seventeen to Twenty-two)

**4. Severe Depression (Greater than twenty-four)**

## Cross sectional analysis at Month 3:

## Eyeballing the data:

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Looking at these graphs, we can say that the treatment 2 has lowest mean Hamilton depression score as compared to others.

Goodness of fit assumptions:

* 1. Normality is violated.
  2. HOV assumption met.
  3. Independence met.

Square root transformation is needed to correct the Normality. Even after square root transformation the normality is NOT corrected so we will be using the original Y variable.

Effect of treatment on the Outcome (Hamilton depression score i.e., SIGHD17)

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The p-value indicate that the four treatments are not significant different from one another in treating the depression.

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We see that all the treatment has mean depression score less than 7 means -No depression.

Also, none of the treatment is significant different from one another.

Including covariates into the model (PS\_HAM17):

COVARIATE is any continuous variable, which is usually not controlled during data collection. Including covariates, the model allows you to include and adjust for input variables that were measured but not randomized or controlled in the experiment. Adding covariates can greatly improve the accuracy of the model and may significantly affect the final analysis results. Including a covariate in the model can reduce the error in the model to increase the power of the factor tests.

Check for equal slope assumption:

In the ANCOVA Model, there should not exist any interaction between the X and covariate (Z). If it exists, then it’s no longer a ANCOVA model.

The assumption is met so we can consider it as covariate

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p-value of interaction is 0.5422 (do not reject null means no significant interaction)

We do not have sufficient evidence indicating the significant interaction between baseline Hamilton depression score and treatment level in the prediction of Hamilton depression score at Month 3.

We will assume the Consistency of slope assumption has been met.

Normality assumption is violated so we will try to transform it. We took the square root transformation. The variability indicated by the r square has improved by adding the covariate into the model. Also, we see that the baseline HD covariate in significant.

Treatments for the Hamilton depression score at month 3 are not significant different from one another.

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Results after backtransforming:

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It indicates that the Hamilton depression score at Month 3 does not varies differently across different level of treatments.

Also, we see that:

MS error for this ANCOVA (1.153) is less that from the ANOVA (1.32) -- Thus adding the covariate in the model improved the R-square value. In the other words we can say that it reduced the unexplained variance of the outcome.

**Including the other variables into the model and 2/3-way interaction terms into the model:**

In ANOVA we have categorical predictor predicting the continuous outcome so we will include one of the following variables into the model to check the two-way interaction.

The categorical variables are:

GENDER

RACE

MAR\_STAT

RACE

CRACK

COMPLETE

SITES

GTHS

SUBHYPOHESIS: Including the GENDER AND MAR\_STAT into the model:

Since the treatment effect was not significant so we removed that from the model and now we are interested in analyzing the two-way interaction for my a priori variables (Gender and Marital Status). 

The graphs look like this:

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On eyeballing the graphs: It looks like the married/cohabiting male have the lowest Hamilton depression score and the Married/cohabiting Females have highest depression score.

Two-way plot:

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1. We are anticipating disordinal INTEARACTION between the gender and marital status without adjusting for the covariate but when we adjusted for the covariate the interaction is no longer significant.
2. Looks like he married female have more depression.

Fitting the ANCOVA MODEL:

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Looks like:

* 1. The interaction between the gender and marital status is NOT significant which means that the on average difference in the SIGHD17 score for male and females DOES NOT vary differentially across different level of marital status (after controlling for covariate).
  2. There is main effect due to the gender term. However, the mar\_stat is not significant.
  3. The covariate included in the model is also significant.

**Output from the LSMEANS:**

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There is significant difference among the married male (2) and the married single (1). Also, there is significant difference of HD score among the married male (2) and married female (4) . Similarly significant difference of HD score among the married male (2) and single female (3). It means that the Male married is significantly different from all the other three categories.

# Conclusion: “Marriage/Cohabiting means less chance of depression for men”.

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Estimates and Contrasts Conclusions:

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We also performed the various estimates and contrasts to check the relationship. Again, the results are same:

1. Alone vs Married is not significant which means there is **no main effect due to marital status.**
2. Male vs Female is significant which means there is **main effect due to the Gender.**
3. **Male Alone vs Male Married is significant** which means being married appears to be associated with a lower risk of Hamilton depressive symptoms in men.
4. **Female Alone vs Female Married is NOT significant** which means there is no effect of marital status on depression for females.
5. **Contrast between the Male Married compared to the average of other three** (Male living alone, Female Single, Female Married) revealed that Male married have **significant** lowest depression score compared to the average.
6. Contrast between the Female Married compared to the average of other three (Male Married, Male living alone, Female Single) revealed that Female married have more depression score compared to the average but that is not significant different.

Back Transformed Output:

Table

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Conclusions Being married appears to be associated with a lower risk of depressive symptoms in men, but not in women.

Including another variable to perform three-way interaction:

We selected the Race variable a priori to include into the model. Now our model has Race, MAR\_STAT and Gender variable.

Slice effect for eyeballing the data:



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Table

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Its shows that the Race=1 (C) anf Marital status =0 (Living alone) for male and female are significantly different from one another.

Its shows that the Race=1 (C) anf Marital status =1 (Married) for male and female are significantly different from one another.

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* It shows that the there is significant difference in the non-Caucasian and those living alone when compared to those who are married.



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* Caucasian Male and Female are significantly different from one another.

Fitting the ANCOVA model:

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It shows that the three-way interaction is not significant. In the other words, on average difference in Y (SIGHD17 score on square root scale) varying as a function of Gender (Male and female) over Marital status (married and living alone) does not varies differential across different level of RACE groups.

LSMEANS OUTPUT:

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Estimates and contrasts:

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1. Caucasian Living alone females have the highest depression score followed by the caucasian married females.
2. Looking at he contrats we see that, there is significant difference in the HD score between CAUCASIAN ALONE FEMALE and CAUCASIAN ALONE MALE with the females having more depression.
3. There is significant difference in the HD score between CAUCASIAN MARRIED FEMALE and CAUCASIAN MARRIED MALE with the females having more depression.

So we can say that the CAUCASIAN FEMALE have more depression score regardless of the marital status as compared to mens.

Final Parsimonious Model: we removed all the non-significant variables from the model and re ran the model.

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1. The average depression score for male and female varies differentailly across different levels of the race (Caucasian and Non-Caucasian)
2. There is main effect due to the race and Marital status means that Caucasian and Non-Caucasian are significant different from one another.Simlarly the average depression score for married and living alone are significantly different.

Lsmeans Output:

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Conclusion: **Caucasian Females** have significant higher depression score than the other three categoreis.

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