Problem Statement

Best Media is currently experiencing a decline in subscription and renewal rates. To address this, the product manager proposes implementing a free 7-day trial of the premium package to attract users and boost subscriptions. He believes that by offering this free trial, users will have an insight on the features of the premium package and thus start buying and renewing their package Best media's data team, consisting of data analysts and scientists, has been tasked with assessing the feasibility and effectiveness of this approach.

Statistical framework
Alpa: 0.05, Statistical power: 0.8, MDE: 1%, Success matrix: Subscription renewal rate (no of sub_renewal / no of users), Target population: Active users, Duration of Experiment: 21 days, Sample size: 10,000 from each group, Control group: No free trial, Treatment group: free Trial,

In [1]:

```python
# Import all necessary packages
import numpy as np
import pandas as pd
import scipy.stats as stats
import statsmodels.stats.api as sms
import matplotlib as mpl
import matplotlib.pyplot as plt
import seaborn as sns
```

In [2]:

```
#now lets load in our csv file
df = pd.read_csv(r'C:\Users\agozi\Desktop\DATA\AB_test_data2.csv')

#lets print the dataset to see if it loaded correctly
print(df)
```

```
                                     User_ID                Name  \
0       f7b560dd-ca0b-4a1d-8ddf-3d0c438d6204      Heather Barber   
1       aaac1414-7e61-4720-a264-854c570f5730    Rebecca Williams   
2       9bb41cfe-8094-48f0-8cca-3ef0cdd5462f        Joseph Davis   
3       98691e09-5c40-4c79-a31b-fc049f7a7160     Anita Schroeder   
4       6de2b129-501d-4fe7-bd14-de6d9459654c     Jennifer Rivera   
...                                      ...                 ...   
499995  464f9090-810c-4222-905b-b1b10bcfcb1a  Elizabeth Martinez   
499996  f256a97e-63ab-48b1-b3a1-a2e5a2df9408        Diane Walton   
499997  421f59fb-5718-404c-8565-0172e75c1328      Kaitlyn Cooper   
499998  325d2112-1f55-4a51-94a0-d3d74bfebfcf        Leslie Davis   
499999  dbbdb191-a9c6-4d9c-8543-8d2de9f07daa       Robert George   

                user_name Subscription_Plan  subscription_upgrade  \
0               joel15950           Premium                 False   
1             andrew66275             Basic                 False   
2               ismith238           Premium                 False   
3           edwardward738             Basic                 False   
4               nblack854           Premium                 False   
...                   ...               ...                   ...   
499995  leonardmichael847           Premium                 False   
499996         kmiller244             Basic                 False   
499997      gomezcindy603             Basic                 False   
499998     nelsonedwin412           Premium                 False   
499999         kgarcia424           Premium                 False   

        Avg_Logins_Per_Week  Gender  Time_Spent_Per_Day  Sign_Up_Year  \
0                         2  Female                1303          2020   
1                        42  Female                 379          2017   
2                         6  Female                 699          2022   
3                        41    Male                 894          2008   
4                        62    Male                1276          2010   
...                     ...     ...                 ...           ...   
499995                   88    Male                1342          2015   
499996                   83  Female                 581          2017   
499997                   85    Male                1142          2020   
499998                    2  Female                 915          2005   
499999                   97  Female                 636          2011   

        first_time_customer   Week_since_last_sign_in      Group  
0                     False                        31    Control  
1                     False                        40    Control  
2                      True                         7    Control  
3                     False                        26    Control  
4                      True                        43    Control  
...                     ...                       ...        ...  
499995                 True                        40  Treatment  
499996                False                        23  Treatment  
499997                False                         4  Treatment  
499998                False                        50  Treatment  
499999                 True                        42  Treatment  

[500000 rows x 12 columns]
```

In [3]:

```
#convert the dataset to a dataframe using pandas
df1 = pd.DataFrame(df)

#show the first ten rows of the dataset
df1.head(10)
```

Out[3]:

	User_ID	Name	user_name	Subscription_Plan	subscription_upgrade	Av
0	f7b560dd-ca0b-4a1d-8ddf-3d0c438d6204	Heather Barber	joel15950	Premium	False	
1	aaac1414-7e61-4720-a264-854c570f5730	Rebecca Williams	andrew66275	Basic	False	
2	9bb41cfe-8094-48f0-8cca-3ef0cdd5462f	Joseph Davis	ismith238	Premium	False	
3	98691e09-5c40-4c79-a31b-fc049f7a7160	Anita Schroeder	edwardward738	Basic	False	
4	6de2b129-501d-4fe7-bd14-de6d9459654c	Jennifer Rivera	nblack854	Premium	False	
5	f0098178-e01f-4721-a54f-ade87e8a944a	Alan Rios	chasebray242	Basic	False	
6	c9fb13d3-744d-44a6-9848-811cff7bf27f	Casey Anderson	elizabethgomez243	Basic	False	
7	2ea3111d-d458-43b9-bf6c-a705a8dedef8	Madison Davis	shermanalan526	Basic	False	
8	a911dd5b-6532-411c-bbde-4e2dd5efc507	Amanda Bailey	joshua68799	Basic	False	
9	6d1612c5-c4bd-4b09-9b7b-8d73b05c7974	William Rios	alexandervazquez458	Basic	False	

In [4]:

```python
# lets check the distribution of the data
df1.describe()
```

Out[4]:

	Avg_Logins_Per_Week	Time_Spent_Per_Day	Sign_Up_Year	Week_since_last_sign_in
count	500000.000000	500000.000000	500000.000000	500000.000000
mean	50.066718	720.449974	2013.990592	26.025708
std	29.141401	416.242578	5.470445	15.304404
min	0.000000	0.000000	2005.000000	0.000000
25%	25.000000	360.000000	2009.000000	13.000000
50%	50.000000	720.000000	2014.000000	26.000000
75%	75.000000	1082.000000	2019.000000	39.000000
max	100.000000	1440.000000	2023.000000	52.000000

In [5]:

```python
# time to clean up the data and leave only the information i need
# first i will start my droping all first time users, since they are not part of thi
df1 = df1.drop(df1[df1['first_time_customer'] == True].index)

#print it out
df1.head(5)
```

Out[5]:

	User_ID	Name	user_name	Subscription_Plan	subscription_upgrade	A
0	f7b560dd-ca0b-4a1d-8ddf-3d0c438d6204	Heather Barber	joel15950	Premium	False	
1	aaac1414-7e61-4720-a264-854c570f5730	Rebecca Williams	andrew66275	Basic	False	
3	98691e09-5c40-4c79-a31b-fc049f7a7160	Anita Schroeder	edwardward738	Basic	False	
9	6d1612c5-c4bd-4b09-9b7b-8d73b05c7974	William Rios	alexandervazquez458	Basic	False	
11	f1dc5e91-20ec-49f8-8ee4-12300fc5b738	Kelly Green	benjaminmarshall864	Premium	False	

In [9]:

```
# Drop rows where 'Time_Spent_Per_Day' is less than 30 mins since we are only workin
df1 = df1.drop(df1[df1['Time_Spent_Per_Day'] < 30].index)

#also lets drop the rows where Week_since_last_sign_in is grater than 4 weeks since
df1 = df1.drop(df1[' Week_since_last_sign_in'] > 4].index)

# Print the DataFrame after dropping the rows
df1.head(10)
```

Out[9]:

	User_ID	Name	user_name	Subscription_Plan	subscription_upgrade	Av
26	a1bf0dcb-4afe-4887-a6db-e96b8c4e8e2d	Beverly Johnson	websterbrittany945	Basic	False	
94	c702a5c1-603e-4b92-8dcb-6d95f670fb90	Elijah Miller	caitlincarson711	Basic	False	
99	a5616e58-9f6b-414b-8a9b-f7c312b53385	Kathy White	khickman213	Basic	False	
122	70513527-077c-455f-a7ce-32d725dfe248	Daniel Rowe	rwright915	Basic	False	
135	6f2d46f6-ee63-4ac5-9406-e2a0093dd70e	Daniel Mcdaniel	blackburnandrea174	Premium	False	
141	b270ff10-2c41-4496-9611-8e78c199356b	Corey Marks	taylorjeremiah645	Basic	False	
147	4c6c29df-2911-485a-9405-1792aedfcc86	Nicole Brown	armstrongkristi250	Basic	False	
149	93cb531c-a700-4aea-994a-c7a474529751	Tammy Rojas	ejenkins179	Basic	False	
150	9247ccc9-7b1e-4bc7-985d-0e4d6979fdc5	Amy Jackson	timothy69137	Basic	False	
187	1d204f76-f99a-4ca6-b619-d4cf59c679d0	Elizabeth Simon	ericharris615	Basic	False	

In [10]:

```python
#let us check the distribution for the data after dropping the necessary rows
df1.describe()
```

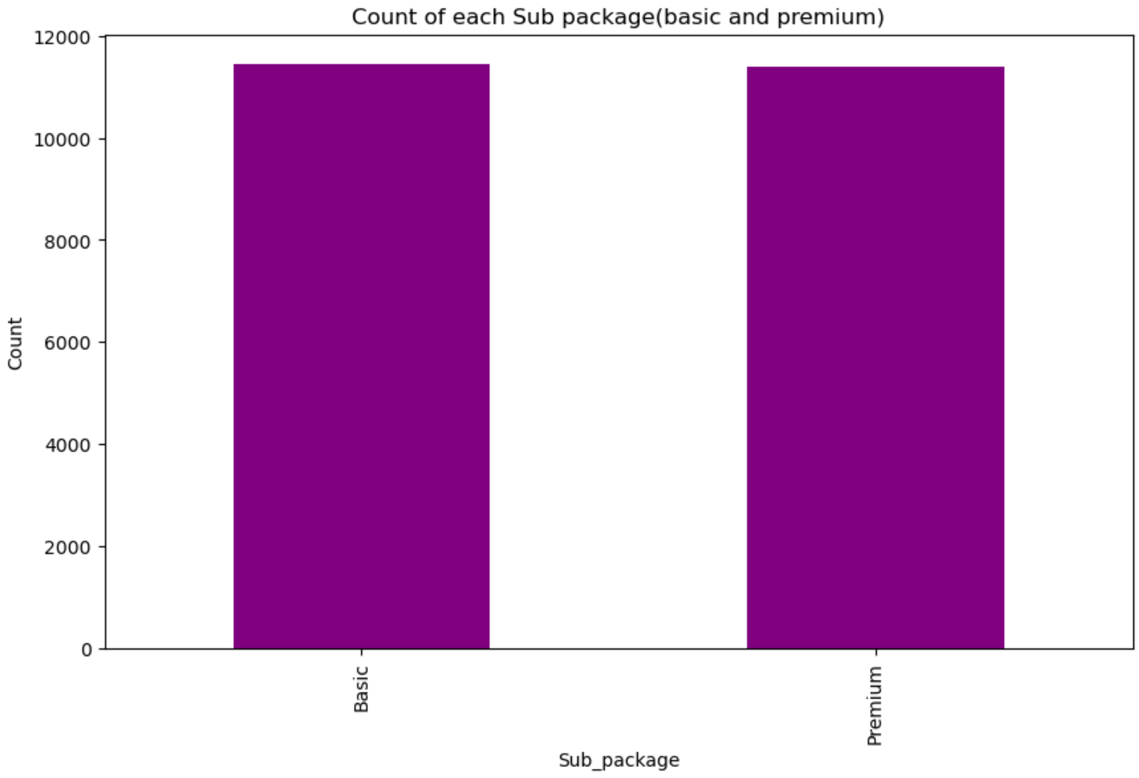
Out[10]:

	Avg_Logins_Per_Week	Time_Spent_Per_Day	Sign_Up_Year	Week_since_last_sign_in
count	22867.000000	22867.000000	22867.000000	22867.000000
mean	49.758648	737.975336	2013.999475	2.007915
std	29.229199	409.576510	5.476563	1.407946
min	0.000000	30.000000	2005.000000	0.000000
25%	24.000000	385.000000	2009.000000	1.000000
50%	50.000000	741.000000	2014.000000	2.000000
75%	75.000000	1091.000000	2019.000000	3.000000
max	100.000000	1440.000000	2023.000000	4.000000

In [12]:

```python
#lets do some basic EDA and see the count and distribution of the basic and premium
# Counting occurrences of each motive
Sub_package = df1['Subscription_Plan'].value_counts()

# Plotting the bar chart
plt.figure(figsize=(10, 6))
Sub_package.plot(kind='bar',color='purple')
plt.xlabel('Sub_package')
plt.ylabel('Count')
plt.title('Count of each Sub package(basic and premium)')
plt.xticks(rotation=90)
plt.show()
```



From the chart above we can clearly see that both packages almost has the same number of users. Let's move on with the analysis and see what we can unfold.

In [14]:

```python
# since we are using a statistical power of 80%, let us now draw our sample from the
# for each group, we will randomly draw a sample of 10,000 users.

control_sample = df1[df1['Group'] == 'Control'].sample(n=10000, random_state=22)
treatment_sample = df1[df1['Group'] == 'Treatment'].sample(n=10000, random_state=22)

ab_test2 = pd.concat([control_sample, treatment_sample], axis=0)
ab_test2.reset_index(drop=True, inplace=True)

# show the first 10 rows of the smapled data
ab_test2.head(10)
```

Out[14]:

	User_ID	Name	user_name	Subscription_Plan	subscription_upgrade	Avg_
0	f97c2caa-0b6f-421b-a2db-4080f58e882e	Heather Wright	jessica12975	Premium	True	
1	64b34891-66ab-4cbe-867d-e8f707bc1313	Bobby Kelly	aellis826	Premium	False	
2	ab5cd8ea-6b22-4efc-a2b5-fa44dd918279	Spencer Clark	hward846	Basic	False	
3	cf0c5023-6551-48d1-9f66-33f924656196	Dr. Jared Perez MD	lmartin551	Premium	True	
4	697de0c1-61b7-4909-abb2-8d81379e84cc	Kristen Snyder	greenchristopher413	Basic	False	
5	d94f9c4c-716f-4bc9-ab0d-579dec1ff4b5	Brenda Riddle	carneygregory350	Basic	False	
6	206ed7b9-38fa-42c8-9c68-30ece7fbdb80	Patricia Garcia	brooksandrew396	Basic	False	
7	6a824d15-de3d-4621-9d43-b3967be19052	Nicole Vazquez	ecruz964	Basic	False	
8	f7fa4013-c419-4878-8e58-8b099ad24373	Joseph Ballard	kjimenez317	Premium	False	
9	94e4c0fa-8ba6-4d90-9920-0921206e5b52	Curtis Allison	bjohnson948	Premium	True	

In [16]:

```python
# Check for duplicate entries using the user_id column.....we have already done this
# we have to check again
duplicate_user_ids = ab_test2[ab_test2.duplicated('User_ID', keep=False)]

# Display the duplicate entries
print(duplicate_user_ids)
```

```
Empty DataFrame
Columns: [User_ID, Name, user_name, Subscription_Plan, subscription_upgrad
e, Avg_Logins_Per_Week, Gender, Time_Spent_Per_Day, Sign_Up_Year, first_ti
me_customer,  Week_since_last_sign_in, Group]
Index: []
```

No duplicate entries found, so we move on with the analysis

In [18]:

```python
# Now let us call only the columns we need for this analysis
ab_test2 = ab_test2[['Subscription_Plan', 'subscription_upgrade', 'Group']]

# Also lets Convert 'subscription_upgrade' to binary code (0 for False, 1 for True)
ab_test2['subscription_upgrade'] = ab_test2['subscription_upgrade'].astype(int)

#print the first 10 rows
ab_test2.head(10)
```

Out[18]:

	Subscription_Plan	subscription_upgrade	Group
0	Premium	1	Control
1	Premium	0	Control
2	Basic	0	Control
3	Premium	1	Control
4	Basic	0	Control
5	Basic	0	Control
6	Basic	0	Control
7	Basic	0	Control
8	Premium	0	Control
9	Premium	1	Control

In [22]:

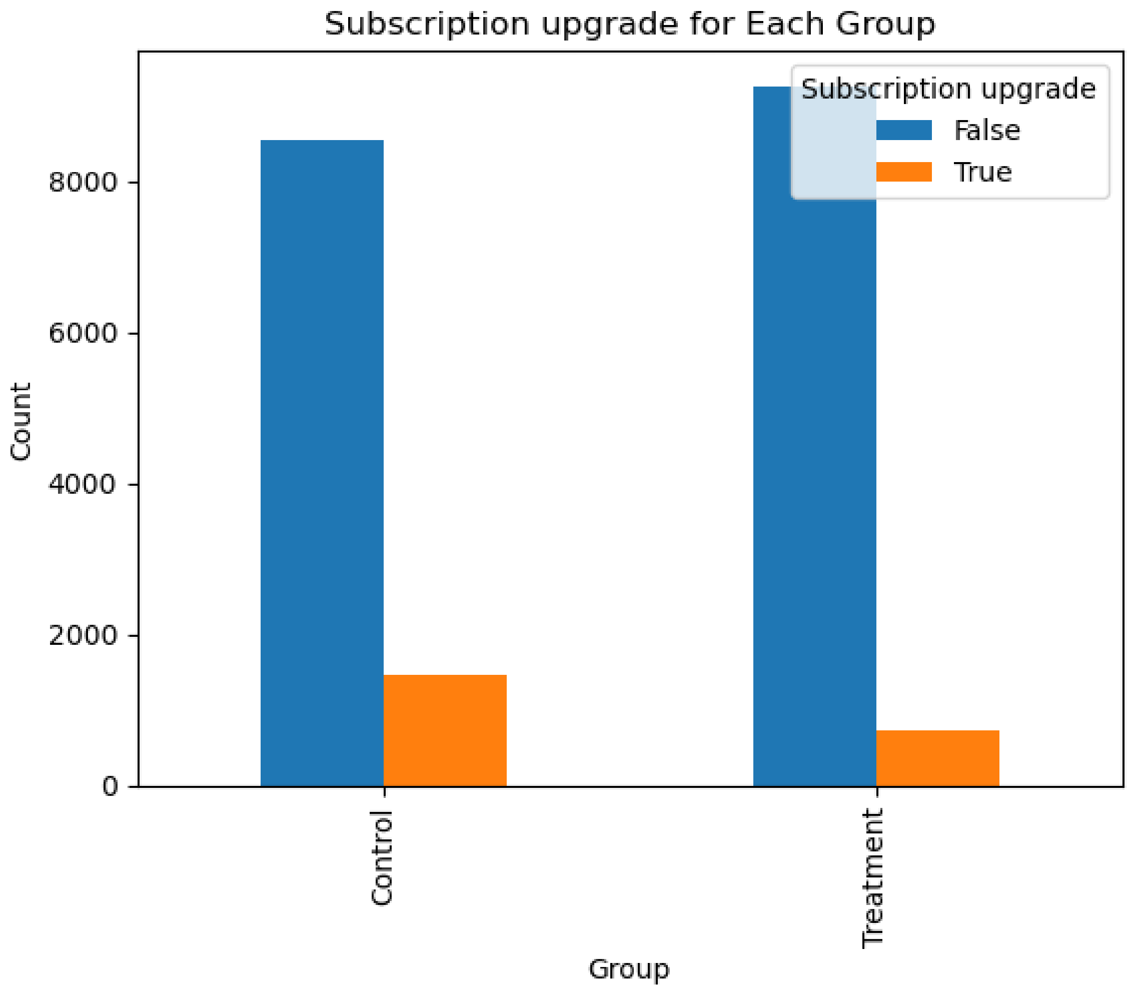
```
# lets visualize how each group performed in tearms of subscription upgrade
# Group the data by 'Group' and 'Subscription_upgrade' and calculate the counts
upgrade_counts = ab_test2.groupby(['Group', 'subscription_upgrade']).size().unstack(

# Plot the bar chart
upgrade_counts.plot(kind='bar')

# Customize the chart labels and title
plt.xlabel('Group')
plt.ylabel('Count')
plt.title('Subscription upgrade for Each Group')
plt.legend(title='Subscription upgrade', loc='upper right', labels=['False', 'True']

# Show the plot
plt.show()

```



From the chart, the treatment group performed lower than the control group. we will keep on with the analysis and see what out test will say.

In [32]:

```python
# Calculate the subscription renewal rate for each group
renewal_rate = ab_test2.groupby('Group')['subscription_upgrade'].sum() / df.groupby(

# Print the subscription renewal rate for each group
print("Subscription Renewal Rate for Each Group:")
print(renewal_rate)
```

```
Subscription Renewal Rate for Each Group:
Group
Control      0.005844
Treatment    0.002964
Name: subscription_upgrade, dtype: float64
```

Judging by the stats above, it does look like our two groups performed very differently, with the control group performing better than the treatment group, approx 0.5% vs 0.2% subscription renewal rate.

In [34]:

```python
# Calculate the lift
control_rate = 0.005844
treatment_rate = 0.002964

lift = (treatment_rate - control_rate) / control_rate

print("Lift:", lift)
```

```
Lift: -0.49281314168377827
```

A negative lift of -49.29% indicates that the treatment group (offering a 7-day free trial) performs approximately 49.29% worse than the control group (not offering any free trial). In other words, the subscription renewal rate in the treatment group is significantly lower than the subscription renewal rate in the control group.

Testing the hypothesis

Null Hypothesis(H0): Offering a 7-day free trial of the premium subscription plan will lead to a higher subscription rate compared to not offering any free trial.

Alternative Hypothesis(H1): Offering a 7-day free trial of the premium subscription plan will not lead to a higher subscription rate compared to not offering any free trial.

In [30]:

```python
# import statsmodel since i failled to import it ealier
from statsmodels.stats.proportion import proportions_ztest, proportion_confint

# Convert 'subscription_upgrade' to binary
ab_test2[' subscription_upgrade'] = ab_test2['subscription_upgrade'].astype(int)

# Perform the proportions z-test between the control and treatment groups
c_results = ab_test2.loc[ab_test2['Group'] == 'Control', ' subscription_upgrade']
t_results = ab_test2.loc[ab_test2['Group'] == 'Treatment', ' subscription_upgrade']

test_stat, pvalue = proportions_ztest([c_results.sum(), t_results.sum()],
                                      nobs=[len(c_results), len(t_results)])

print(f'Test Stat: {test_stat:.4f}')
print(f'p-value: {pvalue:.4f}')
```

```
Test Stat: 16.2650
p-value: 0.0000
```

Since the p-value is 0.0000 (or very close to zero), it means that the probability of obtaining the observed test statistic (16.2650) by random chance, assuming the null hypothesis is true, is essentially negligible. This suggests strong evidence against the null hypothesis.

Conclusion:

Since the p-value (0.0000) is less than the significance level (alpha = 0.05) we reject the null hypothesis and conclude that offering a 7-day free trial of the premium subscription plan does not lead to a higher subscription renewal rate compared to not offering any free trial. The results suggest that there is a significant difference in subscription renewal rates between the two groups (offering a free trial vs. not offering a free trial), and this difference is in favor of not offering any free trial.

Recommendation

In light of these findings, the following recommendations where made:

1. To optimize the overall quality of the application and elevate user satisfaction, it is imperative to diligently address existing performance issues, such as eliminating delays in loading time and minimizing instances of app crashes. Enhancing the app's smooth functionality will undoubtedly elevate the overall user experience, fostering an increased rate of subscriptions and customer retention.
2. Significantly enhancing the premium feature is vital to compelling users to not only purchase plans but also ensure subscription renewal. This can be achieved by meticulously tailoring content to meet individual user preferences, while also optimizing the interface for intuitive usability. Moreover, granting premium users more expanded access to exclusive content will further incentivize them to invest in and maintain premium subscriptions.
3. Implementing a compulsory survey during the cancellation process is of utmost importance. This strategic measure will serve to gather valuable insights into the reasons behind users' decision to cancel their plans, enabling us to discern patterns and identify areas of improvement. Armed with this essential feedback, we can proactively implement measures to mitigate cancellations and enhance overall user satisfaction.

By earnestly addressing these critical areas for improvement, we are poised to not only bolster our application's performance and premium offerings but also ensure a more profound understanding of our users' needs, consequently fortifying our position in the market and solidifying long-term customer loyalty.