In [35]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
from warnings import filterwarnings
%matplotlib inline
```

In [36]:
```
df = pd.read_csv("Marketing Campaign Performance - data.csv")
df
```

Out[36]:

	country	channel	impressions	clicks	cost	installs	visits	purchases	revenue
0	A	APP-Acquisition-Android	14472269	74022	13,583	12,094	NaN	15226	1839.97
1	A	APP-Acquisition-Android	3057156	27797	4,967	5,403	NaN	4370	763.91
2	A	APP-Acquisition-iOS	537135	8066	4,019	2,394	NaN	1929	749.46
3	A	APP-Acquisition-iOS	518521	7326	3,243	2,100	NaN	1194	452.83
4	A	Web-Retargeting	1851036	8101	1065.45	NaN	7056.0	927	782.33
...	...	...	...	...	...	...	...	...	...
1471	T	SEM-Hotels	1103	18	3.06	NaN	20.0	12	11.27
1472	T	SEM-Hotels	2925	48	2.92	NaN	44.0	1	0.30
1473	T	SEM-Hotels	939	28	2.72	NaN	31.0	4	2.37
1474	T	SEM-Hotels	402	12	1	NaN	12.0	0	NaN
1475	T	SEM-Hotels	375	3	0.22	NaN	3.0	0	NaN

1476 rows × 9 columns

In [37]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1476 entries, 0 to 1475
Data columns (total 9 columns):
 #   Column       Non-Null Count  Dtype  
---  ------       --------------  -----  
 0   country      1476 non-null   object 
 1   channel      1476 non-null   object 
 2   impressions  1476 non-null   int64  
 3   clicks       1476 non-null   int64  
 4   cost         1476 non-null   object 
 5   installs     38 non-null     object 
 6   visits       1428 non-null   float64
 7   purchases    1476 non-null   int64  
 8   revenue      1217 non-null   float64
dtypes: float64(2), int64(3), object(4)
memory usage: 103.9+ KB
```

In [38]:
```
#missing values

df.isna().sum()
```

Out[38]:
```
country           0
channel           0
impressions       0
clicks            0
cost              0
installs       1438
visits           48
purchases         0
revenue         259
dtype: int64
```

In [39]:
```
features_with_na = [features for features in df.columns if df[features].isnull().sum() > 1] #list comprehension to identify null values in Data frame

for feature in features_with_na:
    print(feature, np.round(df[feature].isnull().mean() * 100, 4),  ' % missing values')
```

```
installs 97.4255  % missing values
visits 3.252  % missing values
revenue 17.5474  % missing values
```

As Data is Realtime and no ML model is to be built, so we're avoiding preproprocessing of the data

In [40]:
```
df.fillna(0) # We won't be deleteing any data, replacing all NA values with 0
```

Out[40]:

	country	channel	impressions	clicks	cost	installs	visits	purchases	revenue
0	A	APP-Acquisition-Android	14472269	74022	13,583	12,094	0.0	15226	1839.97
1	A	APP-Acquisition-Android	3057156	27797	4,967	5,403	0.0	4370	763.91
2	A	APP-Acquisition-iOS	537135	8066	4,019	2,394	0.0	1929	749.46
3	A	APP-Acquisition-iOS	518521	7326	3,243	2,100	0.0	1194	452.83
4	A	Web-Retargeting	1851036	8101	1065.45	0	7056.0	927	782.33
...	...	...	...	...	...	...	...	...	...
1471	T	SEM-Hotels	1103	18	3.06	0	20.0	12	11.27
1472	T	SEM-Hotels	2925	48	2.92	0	44.0	1	0.30

	country	channel	impressions	clicks	cost	installs	visits	purchases	revenue
1473	T	SEM-Hotels	939	28	2.72	0	31.0	4	2.37
1474	T	SEM-Hotels	402	12	1	0	12.0	0	0.00
1475	T	SEM-Hotels	375	3	0.22	0	3.0	0	0.00

1476 rows × 9 columns

. All The Numerical Variables **

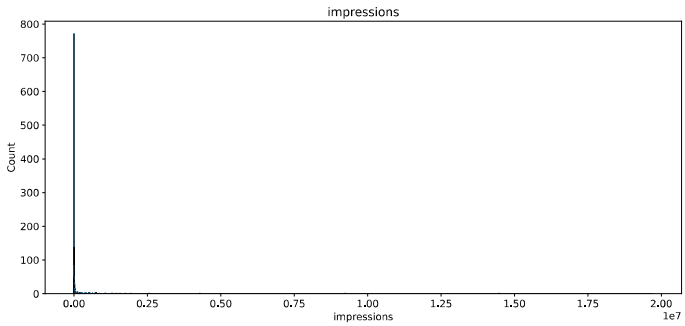
In [41]:
```
numerical_features = [feature for feature in df.columns if df[feature].dtypes != 'O'] # list comprehension feature that are not equal to object type

print('Number of numerical variables: ', len(numerical_features))

# visualise the numerical variables
df[numerical_features].head()
```

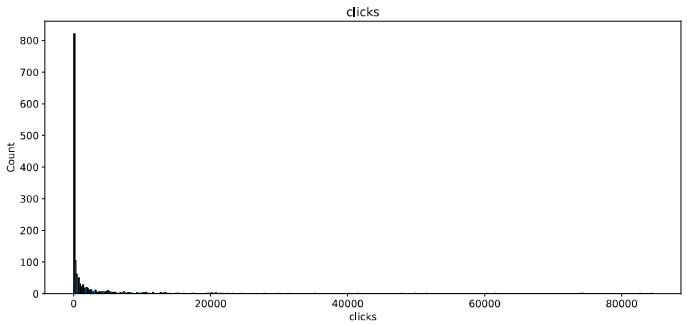
```
Number of numerical variables:  5
```

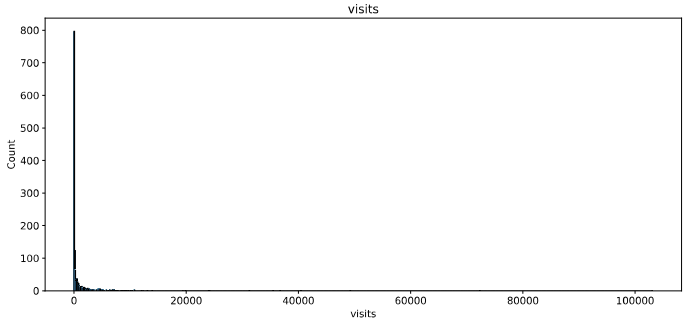
Out[41]:

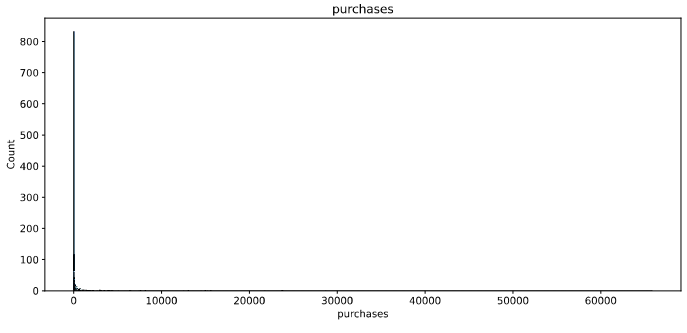
	impressions	clicks	visits	purchases	revenue
0	14472269	74022	NaN	15226	1839.97
1	3057156	27797	NaN	4370	763.91
2	537135	8066	NaN	1929	749.46
3	518521	7326	NaN	1194	452.83
4	1851036	8101	7056.0	927	782.33

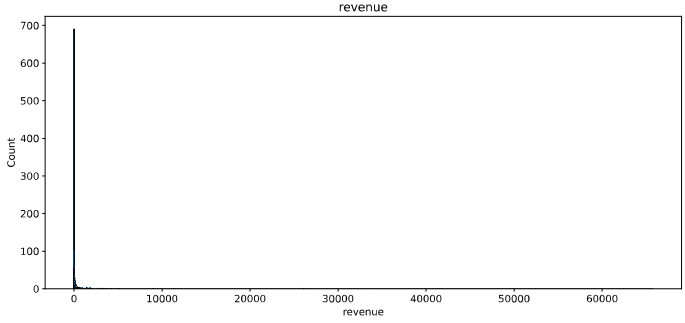
In [42]:
```
# Distribution of the Data, to check skewness of the data

a = 3  # number of rows
b = 2  # number of columns
c = 1  # initialize plot counter

fig = plt.figure(figsize=(30,20))

for i in numerical_features:
    plt.subplot(a, b, c)
    plt.title('{}'.format(i))

    sns.histplot(data= df, x= i)

    c = c + 1

plt.show()
```











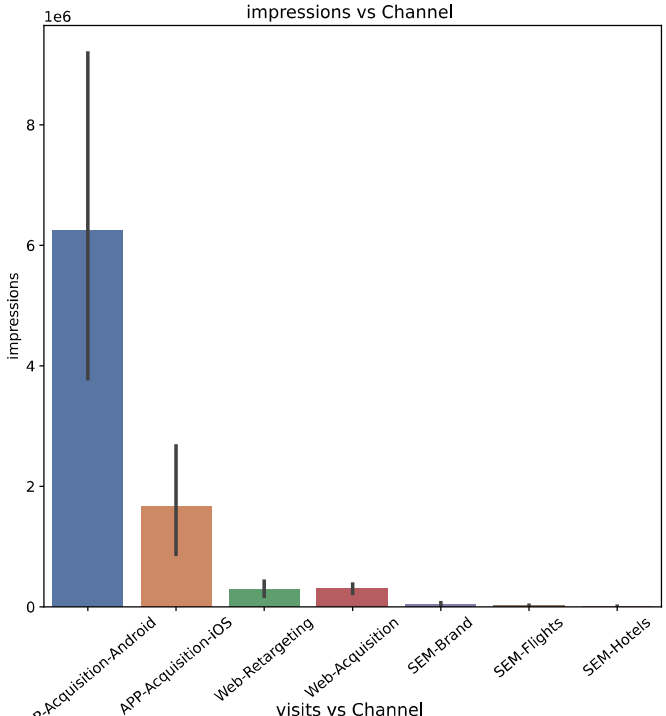
In [43]:
```
## Numerical variables are usually of 2 type
## 1. Continous variable and Discrete Variables
```

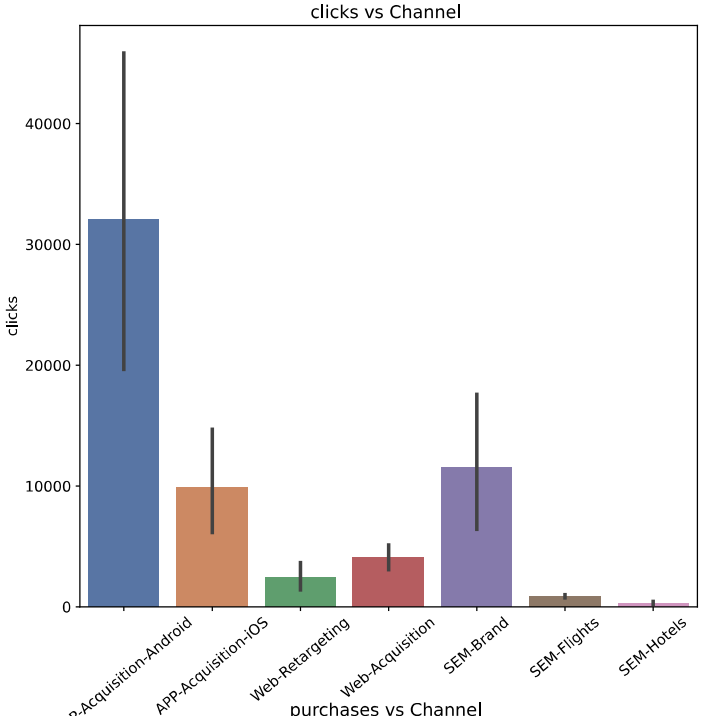
```
discrete_feature=[feature for feature in numerical_features if len(df[feature].unique())]
print("Discrete Variables Count: {}".format(len(discrete_feature)))
```

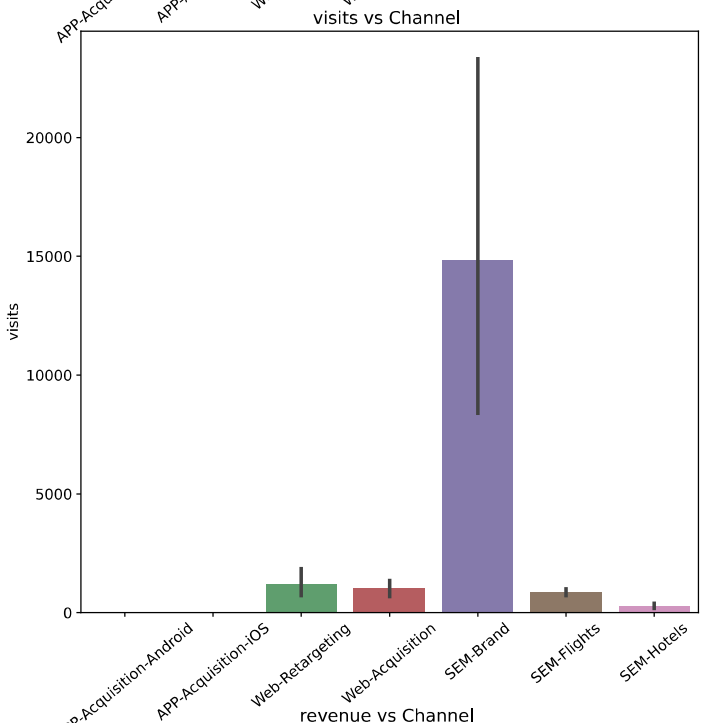
```
Discrete Variables Count: 5
```

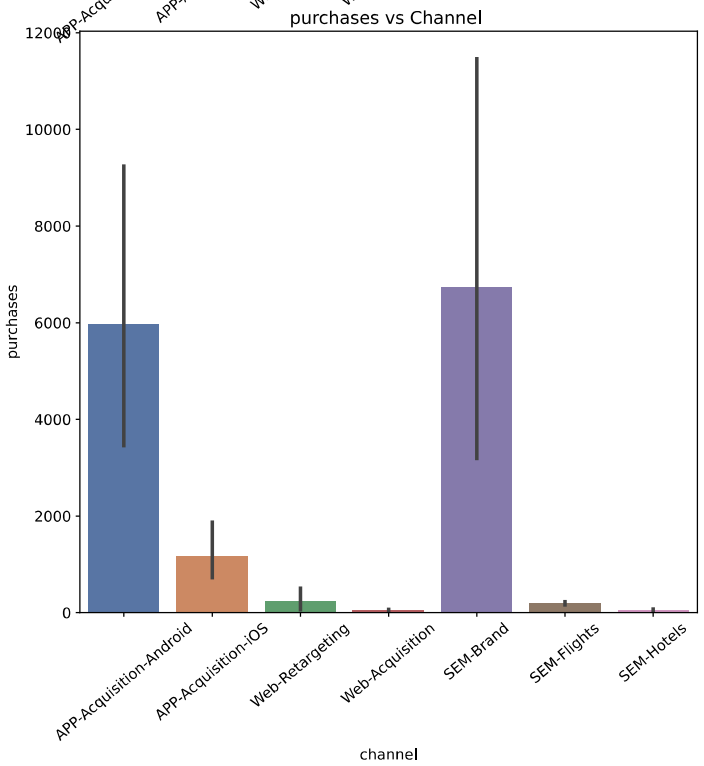
In [44]:

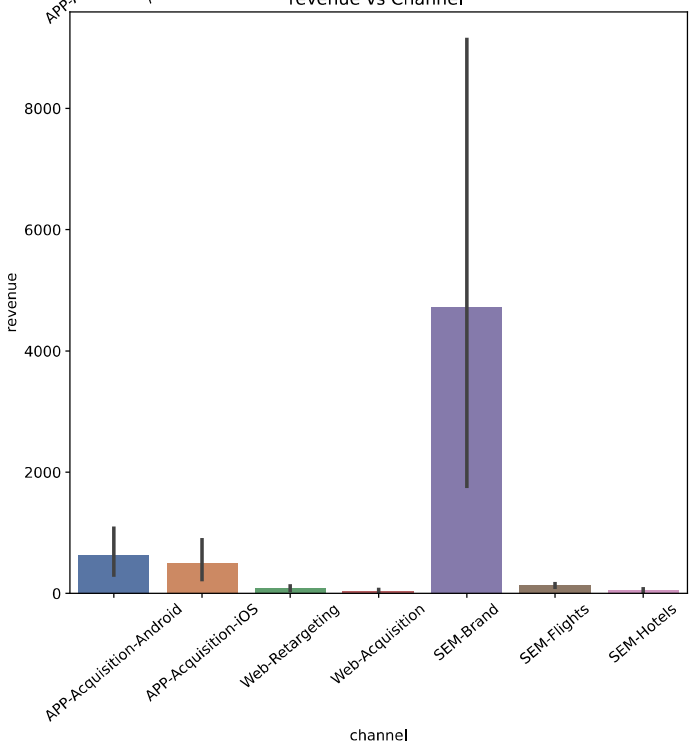
```
a = 5  # number of rows
b = 2  # number of columns
c = 1  # initialize plot counter

fig = plt.figure(figsize=(20, 50))
font = {'size': 12}

# using rc function
plt.rc('font', **font)

for i in numerical_features:
    plt.subplot(a, b, c)
    plt.title('{} vs Channel '.format(i))
    sns.barplot(x= "channel", y=  i, data= df, palette="deep")
    plt.xticks(rotation = 40)
    c = c + 1

plt.show()
```







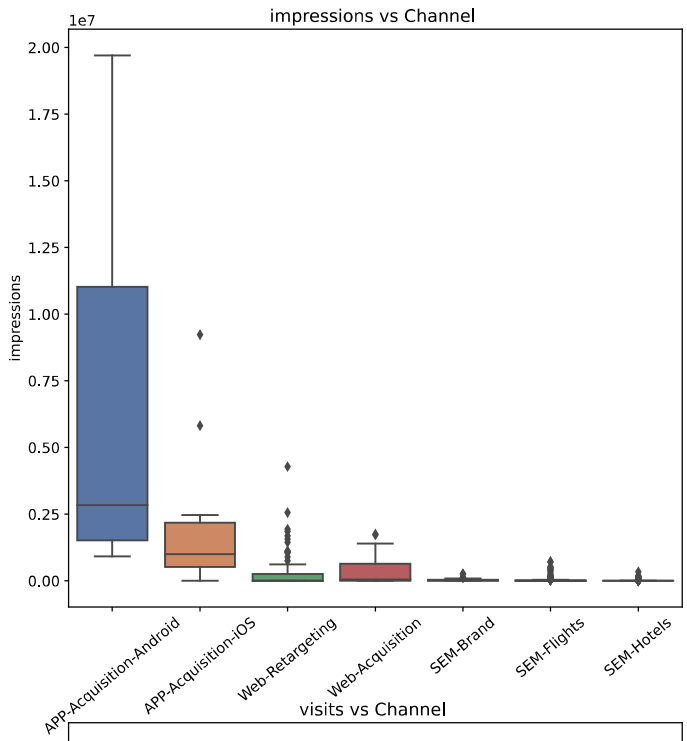


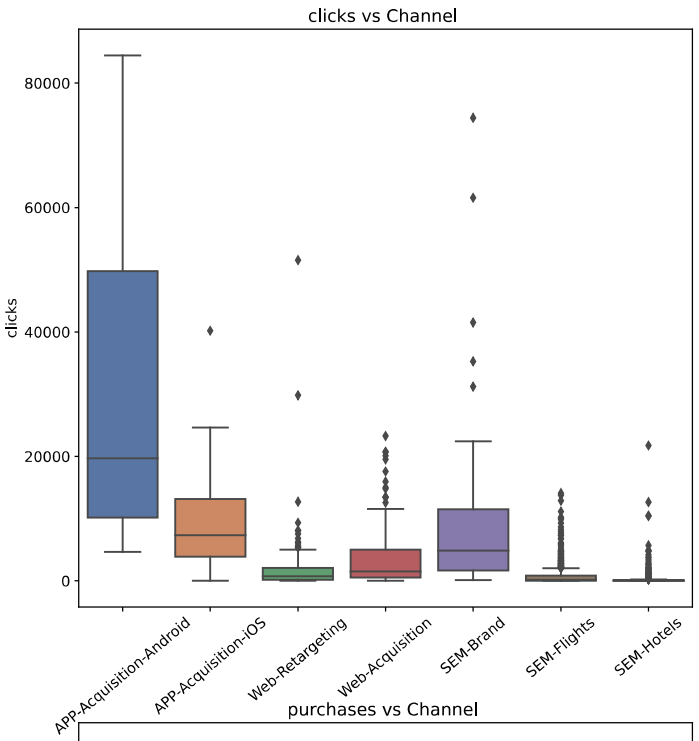


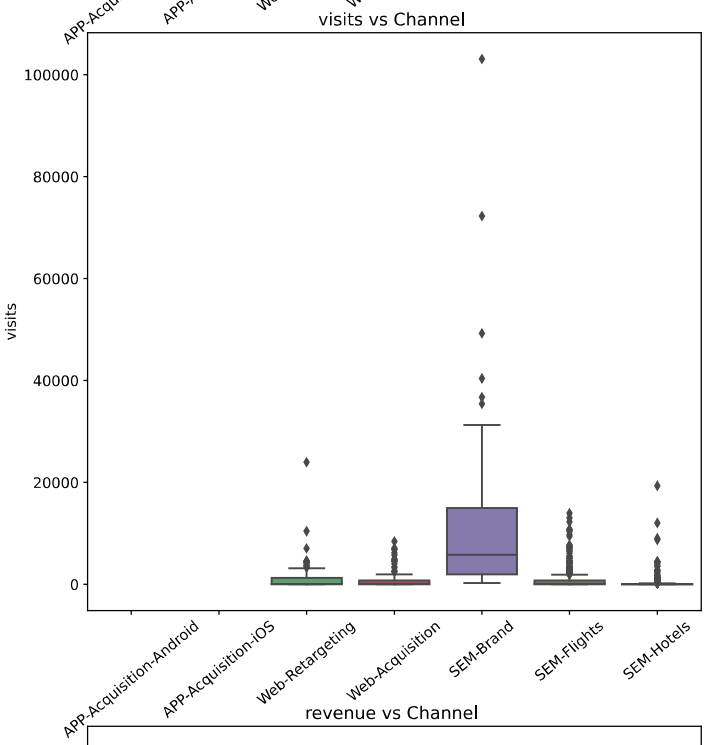
BOXPLOT SHOWS OUTLIERS INCLUDED IN THE DATASET

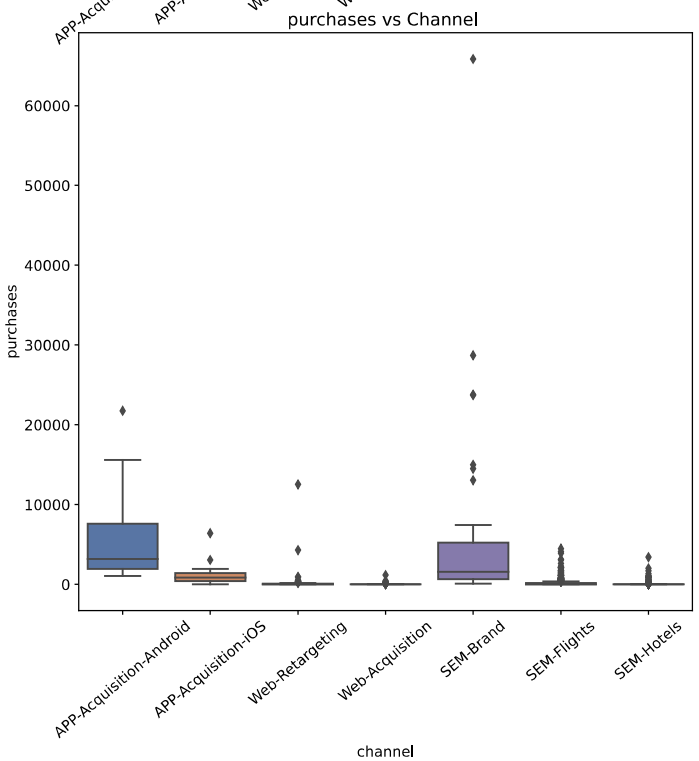
In [45]:

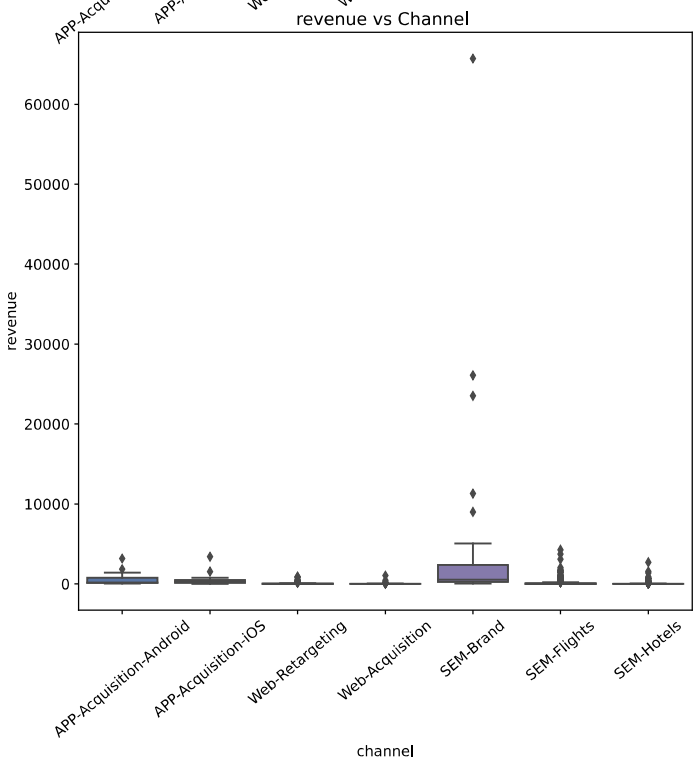
```
a = 5  # number of rows
b = 2  # number of columns
c = 1  # initialize plot counter

fig = plt.figure(figsize=(20, 50))
font = {'size': 12}

# using rc function
plt.rc('font', **font)

for i in numerical_features:
    plt.subplot(a, b, c)
    plt.title('{} vs Channel '.format(i))
    sns.boxplot(x= "channel", y=  i, data= df, palette="deep")
    plt.xticks(rotation = 40)
    c = c + 1

plt.show()
```











In [46]:

```
categorical_features=[feature for feature in df.columns if df[feature].dtypes=='O']
categorical_features
```

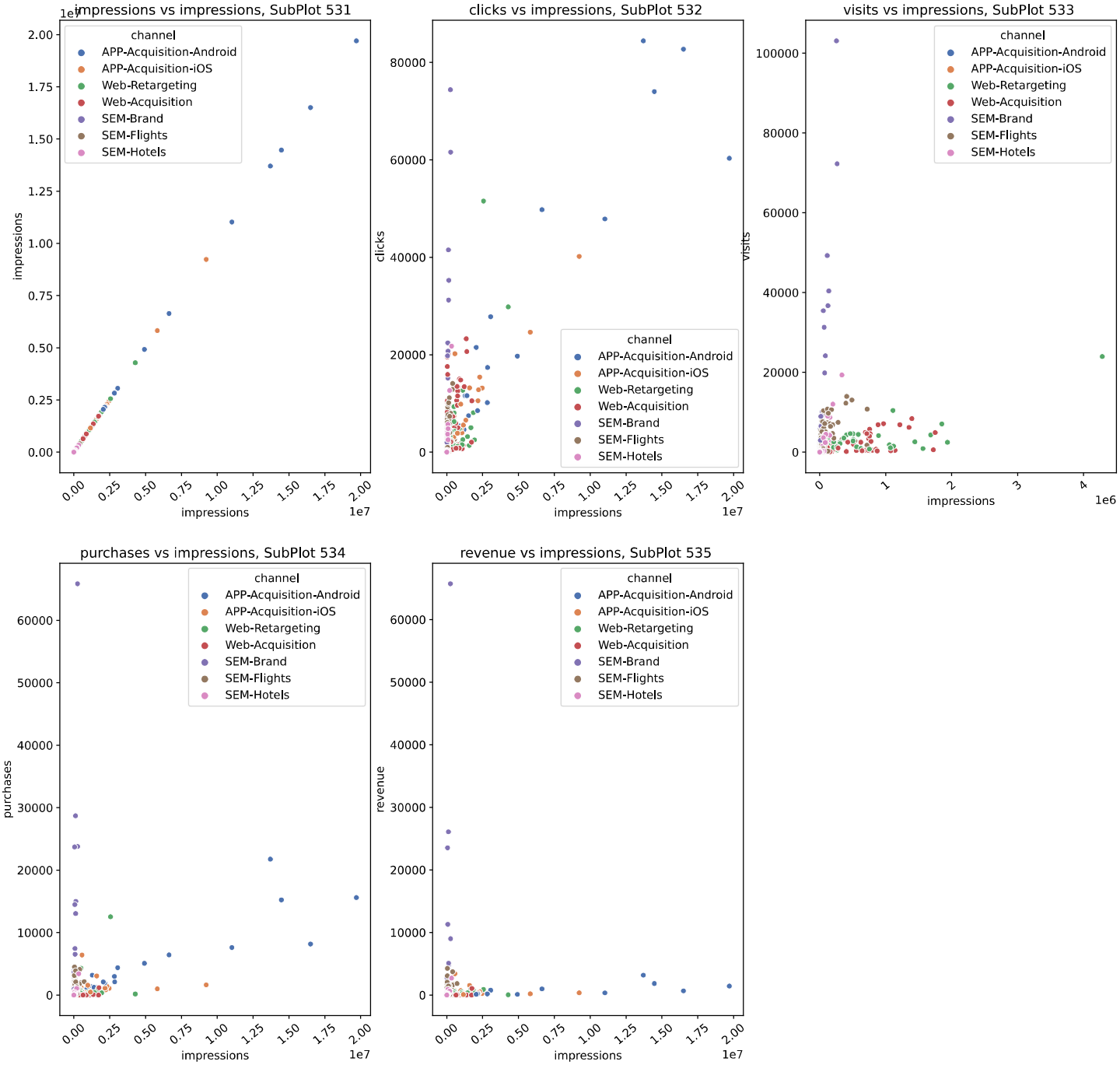
Out[46]:
```
['country', 'channel', 'cost', 'installs']
```

In [47]:
```
for feature in categorical_features:
    print('The feature is {} and number of categories are {}'.format(feature,len(df[feature].unique())))
```

```
The feature is country and number of categories are 10
The feature is channel and number of categories are 7
The feature is cost and number of categories are 1172
The feature is installs and number of categories are 39
```

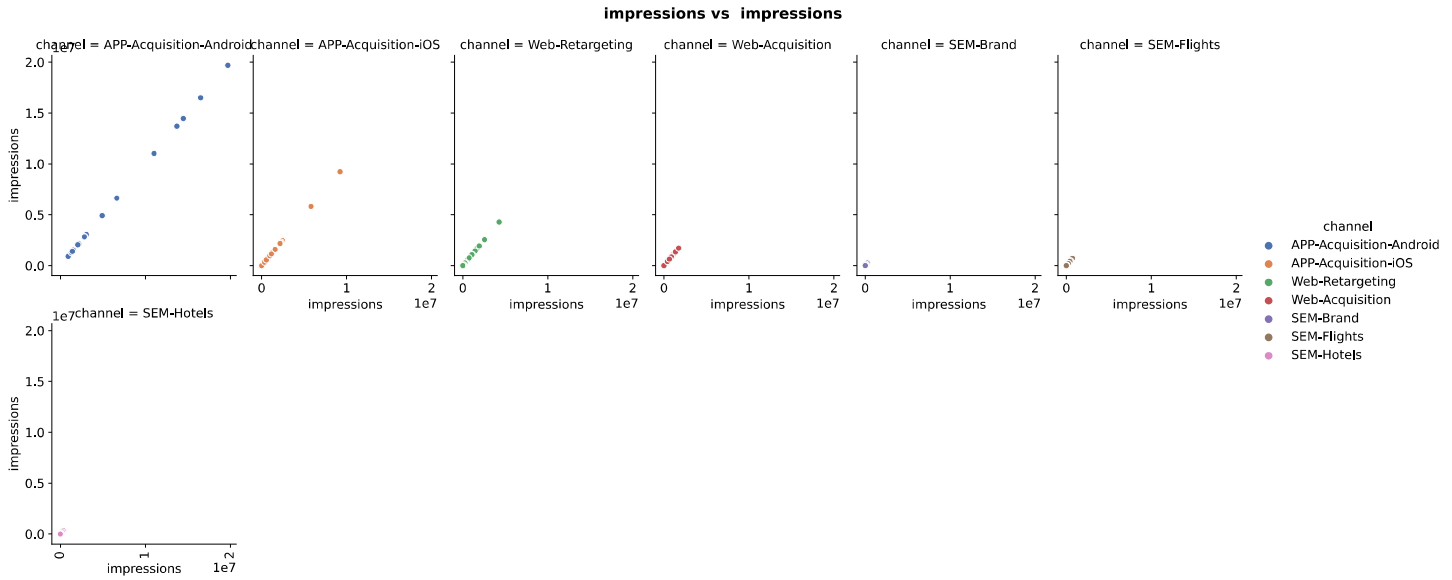
2.1 Which channel's ads do the users like the most? (hint: click through rate or CTR)

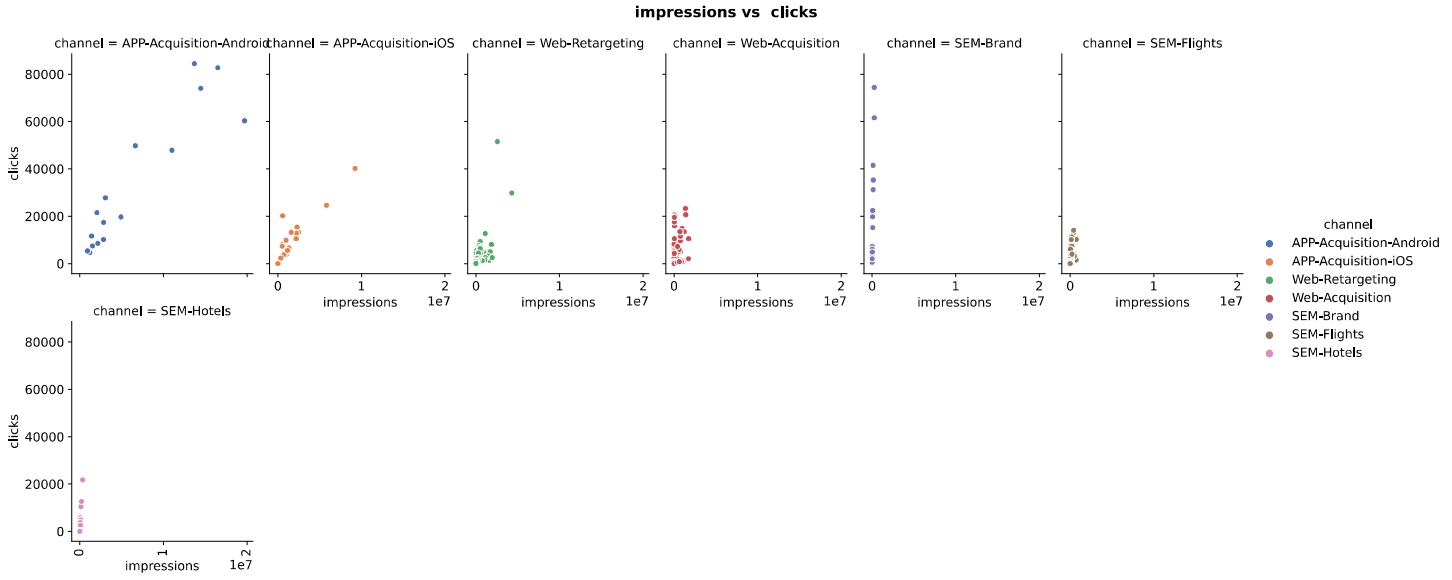
In [48]:
```
a = 5  # number of rows
b = 3  # number of columns
c = 1  # initialize plot counter

fig = plt.figure(figsize=(20, 50))
font = {'size': 12}

# using rc function
plt.rc('font', **font)

for i in numerical_features:
    plt.subplot(a, b, c)
    plt.title('{} vs impressions, SubPlot {}{}{} '.format(i,a, b,c))
    sns.scatterplot(x= "impressions", y=  i, data= df, palette="deep", hue = "channel")
    plt.xticks(rotation = 40)
    c = c + 1

plt.show()
```

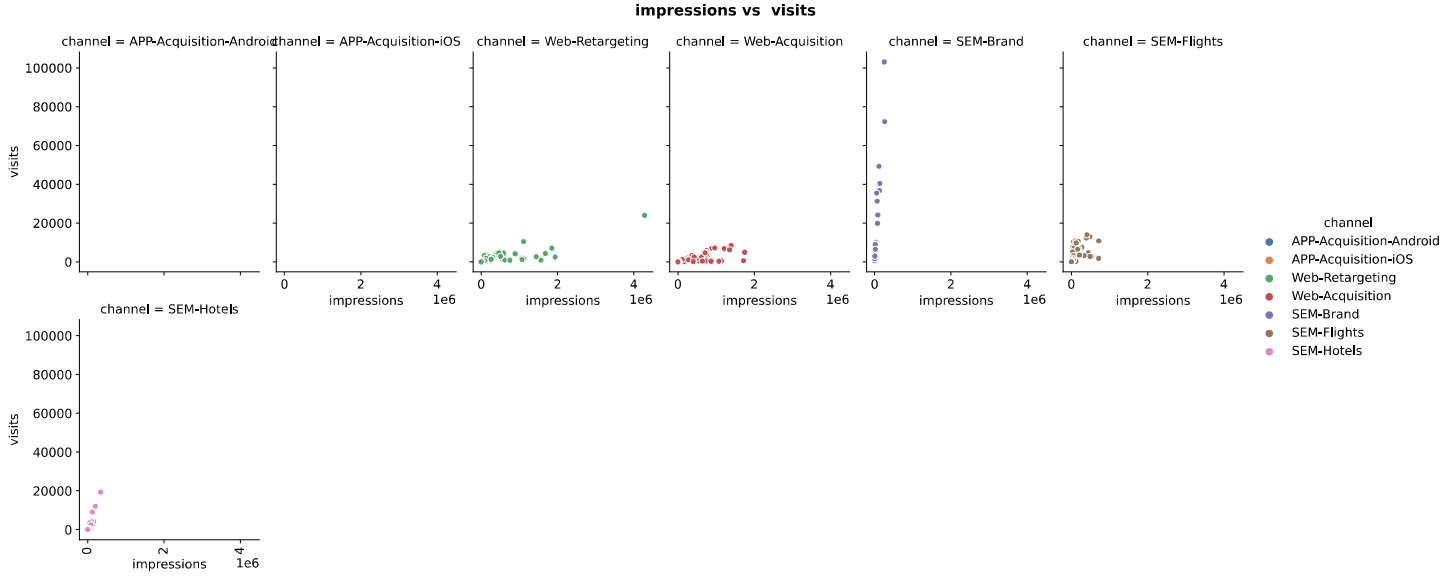


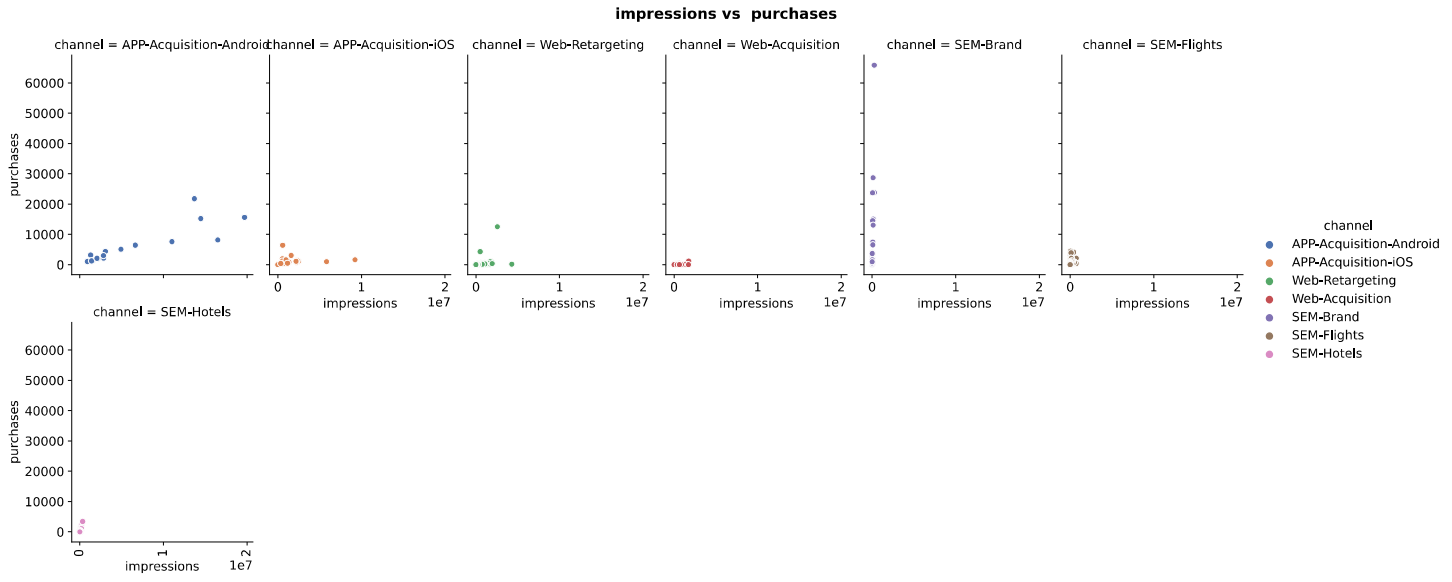
In [49]:
```
for i in numerical_features:
    g = sns.relplot(data=df, x= "impressions", y=i, col= "channel", col_wrap=6, hue= "channel", height= 4, aspect=.7,kind="scatter", legend= True, palet
```

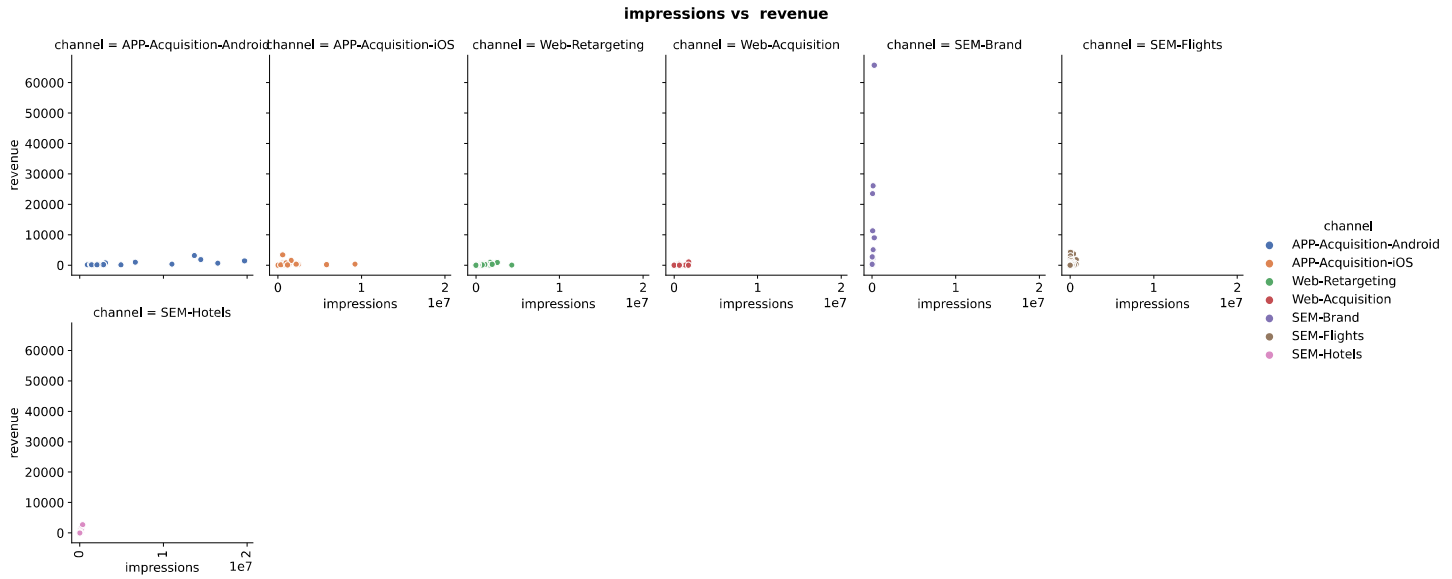
```
    g.fig.suptitle(f" impressions vs  {i} ", fontweight ="bold")
    plt.subplots_adjust(top=.90)
    plt.xticks(rotation = 90)
plt.show()
```











focusing on clicks vs impressions graph, APP - Acqusition Android, APP - Acqusition IOS and Web retargetting are most liked by the users. As they have high click / impressions.

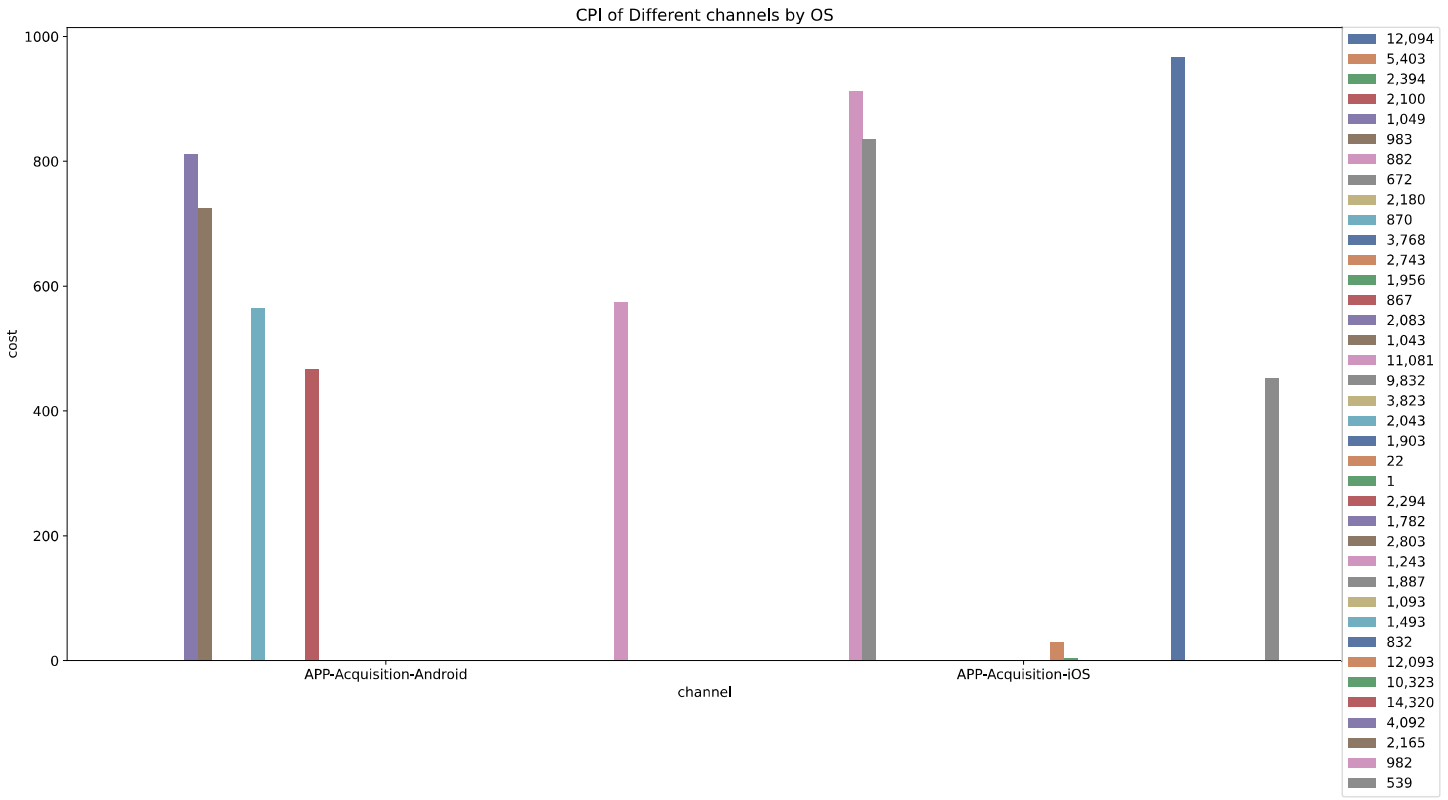
2.2 What's the CPI of App channels (APP-Acquisition-Android and APP-Acquisition-iOS) by country and OS?

In [50]:
```
df["cost"] = pd.to_numeric(df.cost, errors='coerce') #converting cost to numeric data
```

CPI= Cost per install

CPI by OS

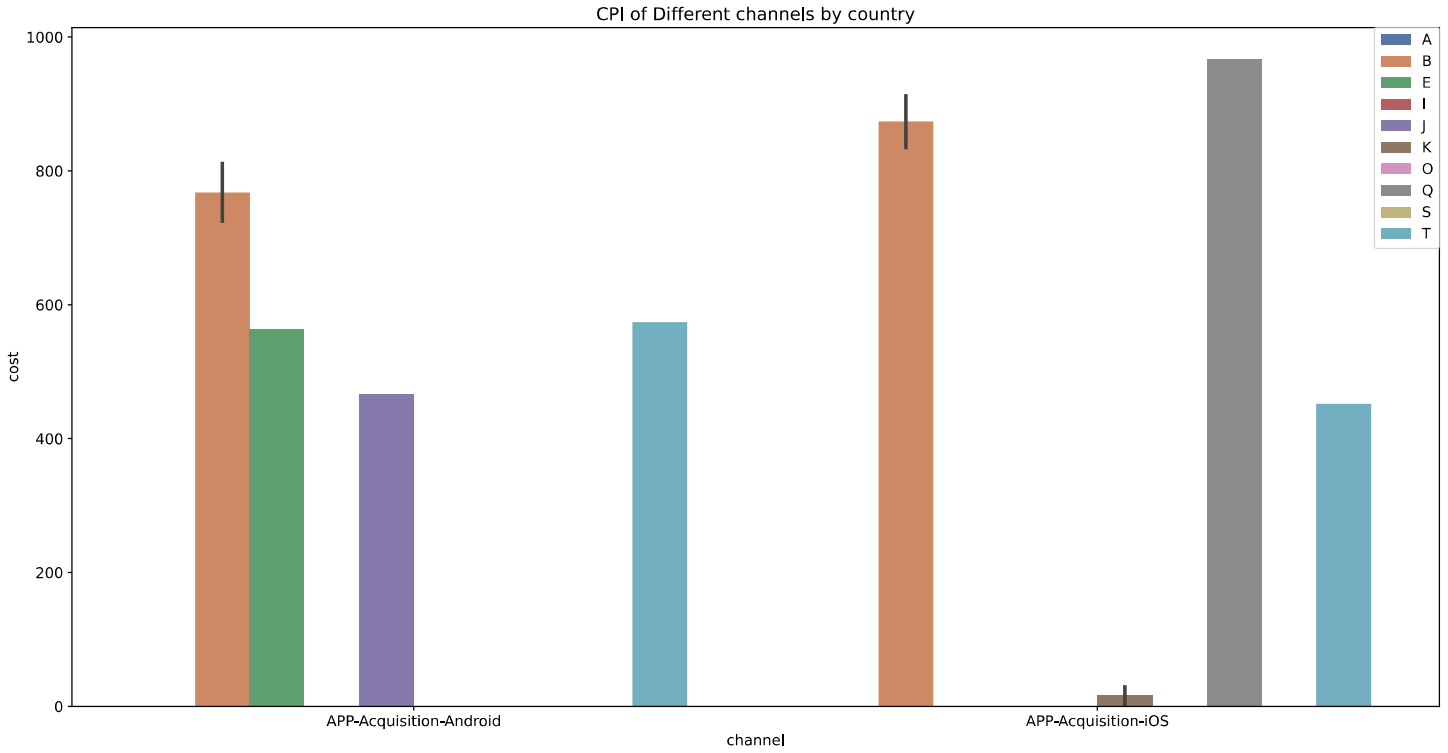
In [51]:
```
plt.figure(figsize=(20,10))
sns.barplot(data = df, x = "channel", y =  "cost", hue = "installs", palette="deep",   order=["APP-Acquisition-Android", "APP-Acquisition-iOS"])
plt.title("CPI of Different channels by OS")
plt.legend(bbox_to_anchor=(1, 1), loc='best', borderaxespad=0.)
plt.show()
```



CPI on basis of different country

In [52]:

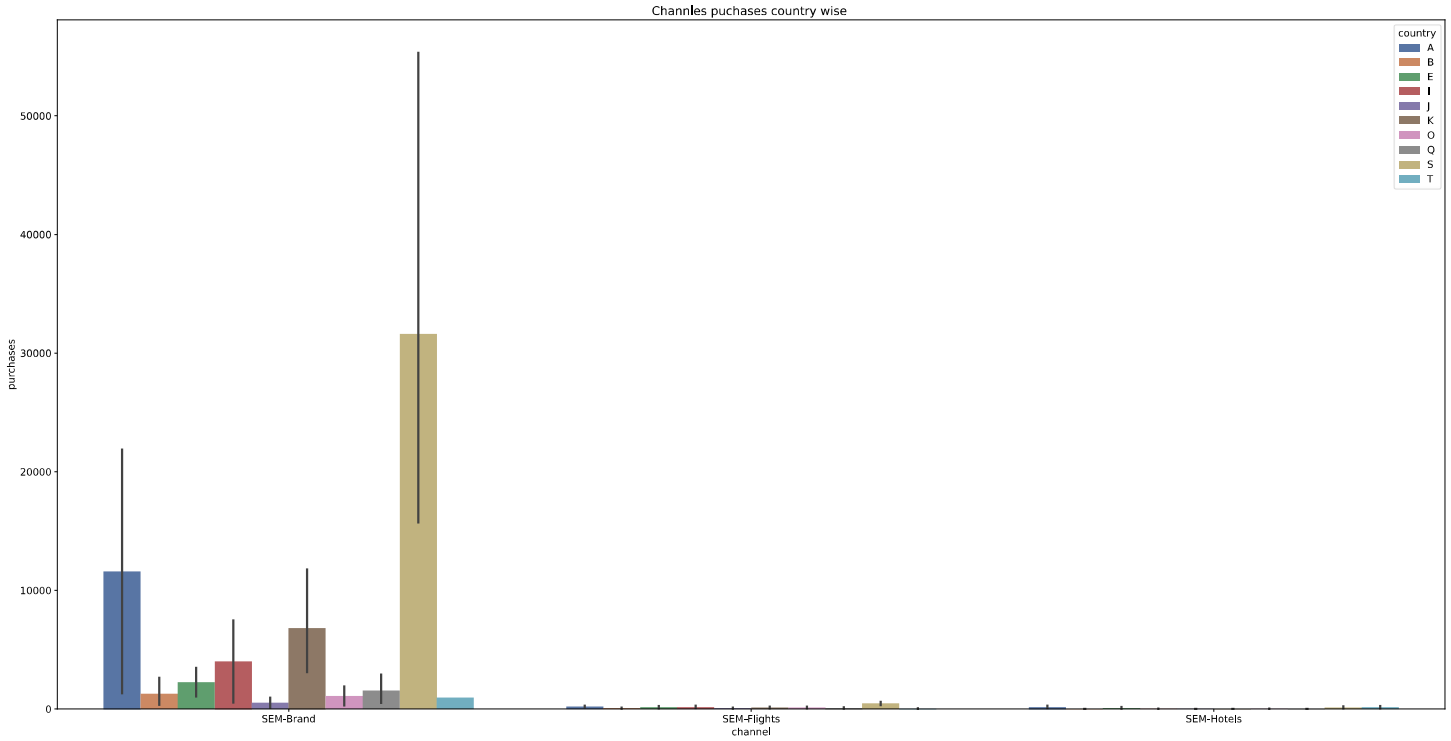
```
plt.figure(figsize=(20,10))
sns.barplot(data = df, x = "channel", y =  "cost", hue = "country", palette="deep",   order=["APP-Acquisition-Android", "APP-Acquisition-iOS"])
plt.title("CPI of Different channels by country")
plt.legend(bbox_to_anchor=(1, 1), loc='best', borderaxespad=0.)
plt.show()
```



2.3 In SEM channels, which country has the best conversion rate?

In [53]:

```
plt.figure(figsize = (30,15))
plt.title('Channles puchases country wise ')
sns.barplot(x= "channel"  , y=  'purchases', data= df, palette="deep", hue = "country" , order=["SEM-Brand", "SEM-Flights", "SEM-Hotels"])
plt.xticks(rotation = 0)
plt.show()
```

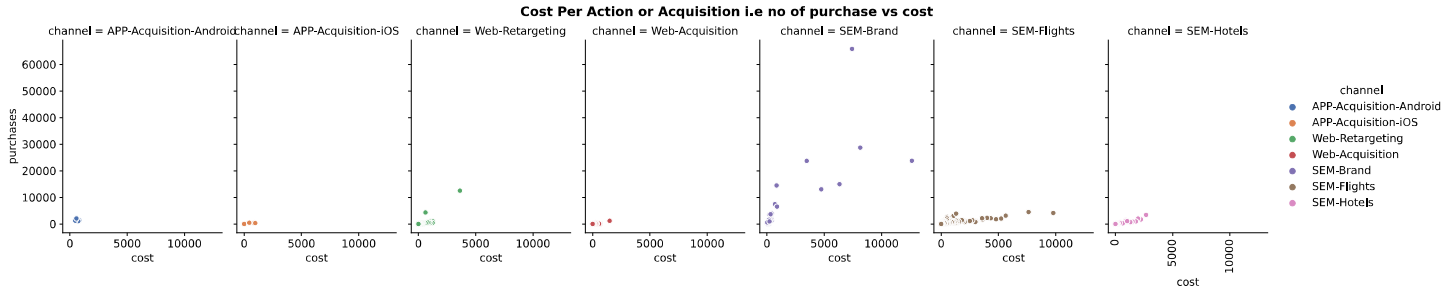


from above graph we can conclude that country S has high conversion Rate as it has maxiumum purchases

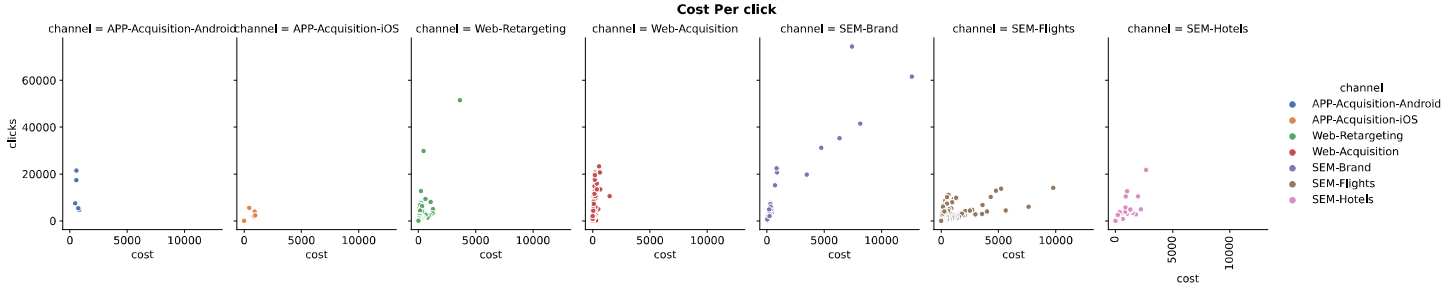
2.4 Which Web channel has better CPA?

(Cost Per Action or Acquisition) , (CPA) is calculated by dividing the total cost of conversions by the total number of conversions

In [54]:
```
g = sns.relplot(data=df, x= "cost", y= 'purchases', col= "channel", col_wrap=7, hue= "channel", height= 4, aspect=.7,kind="scatter", legend= True, palet
g.fig.suptitle(f" Cost Per Action or Acquisition i.e no of purchase vs cost ", fontweight ="bold")
plt.subplots_adjust(top=.85)
plt.xticks(rotation = 90)
plt.show()
```



In [55]:
```
g = sns.relplot(data=df, x= "cost", y= 'clicks', col= "channel", col_wrap=7, hue= "channel", height= 4, aspect=.7,kind="scatter", legend= True, palette=
g.fig.suptitle(f" Cost Per click ", fontweight ="bold")
plt.subplots_adjust(top=.85)
plt.xticks(rotation = 90)
plt.show()
```



CPA of channel SEM brand is better than other channles as, cost of acqusition is less and purchases by customer is moree.

2.5 Identify the top 3 performing channels of each country in terms of ROI.

The basic ROI calculation is: ROI = (Net Profit/Total Cost)*100.

In [56]:
```
ROI = (df.revenue / df.cost) * 100
data = pd.DataFrame(ROI, columns = ["ROI"])
```

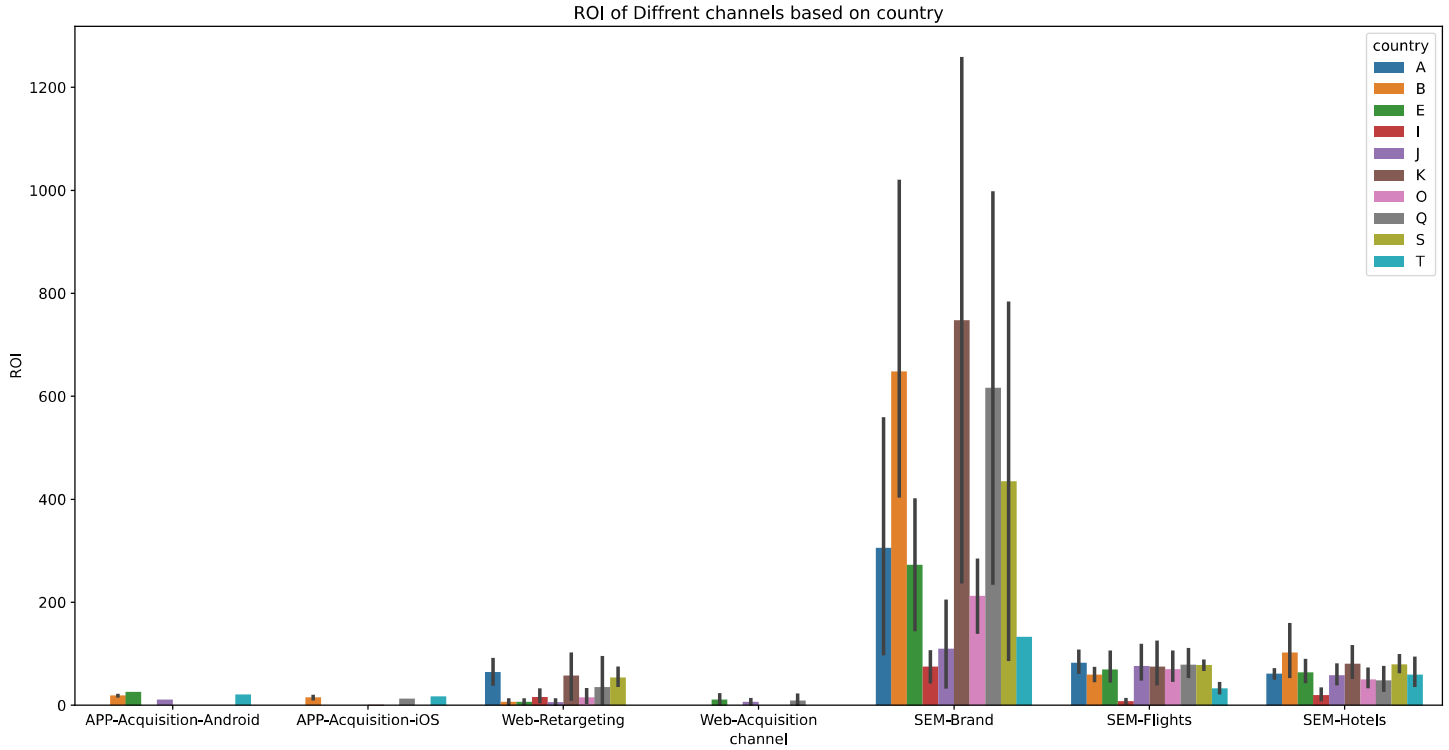
```
# Using DataFrame.insert() to add a column
df["ROI"] = data
```

In [57]:
```
df.head()
```

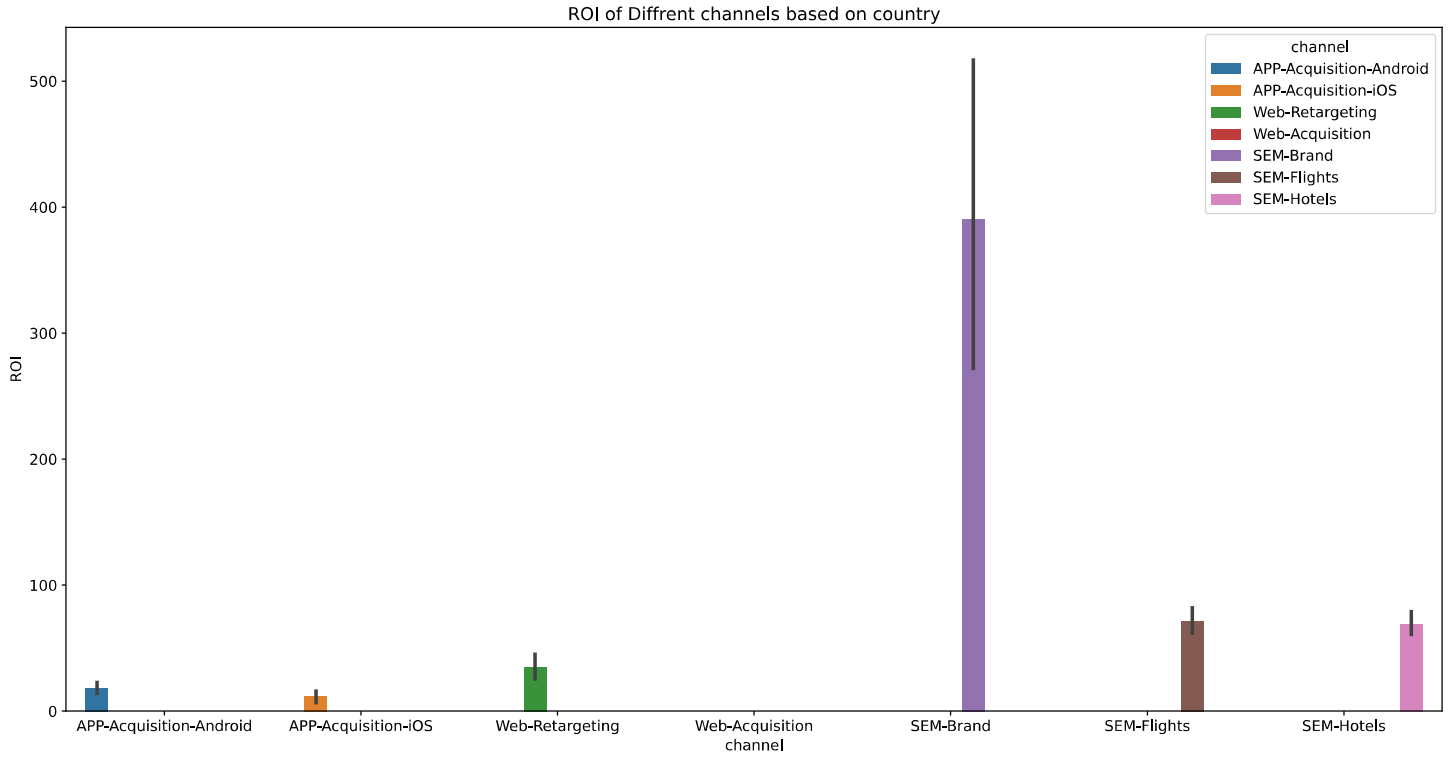
Out[57]:

	country	channel	impressions	clicks	cost	installs	visits	purchases	revenue	ROI
0	A	APP-Acquisition-Android	14472269	74022	NaN	12,094	NaN	15226	1839.97	NaN
1	A	APP-Acquisition-Android	3057156	27797	NaN	5,403	NaN	4370	763.91	NaN
2	A	APP-Acquisition-iOS	537135	8066	NaN	2,394	NaN	1929	749.46	NaN
3	A	APP-Acquisition-iOS	518521	7326	NaN	2,100	NaN	1194	452.83	NaN
4	A	Web-Retargeting	1851036	8101	1065.45	NaN	7056.0	927	782.33	73.42719

In [59]:
```
plt.figure(figsize=(20,10))
sns.barplot(data = df, x = "channel", y = "ROI",  hue = "country")
plt.title("ROI of Diffrent channels based on country")
plt.show()
```

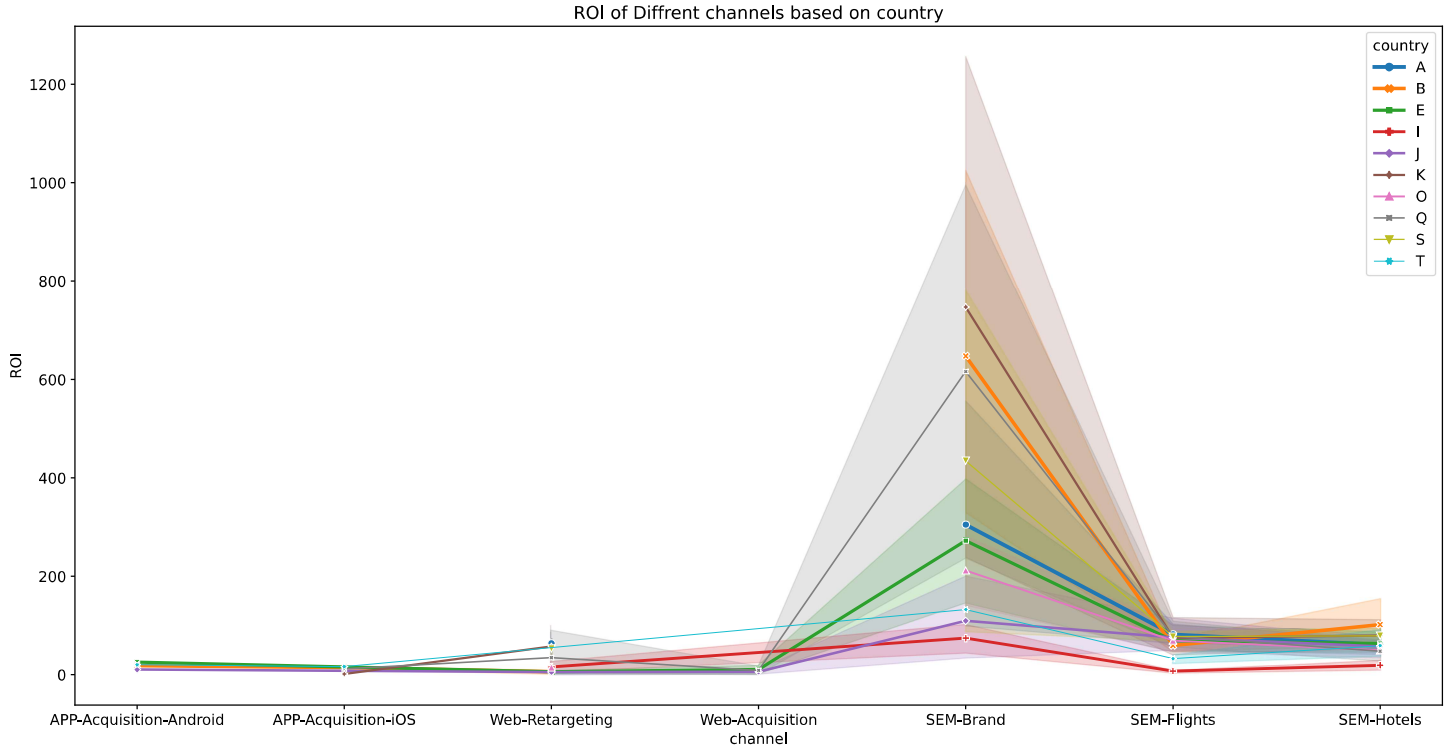


In [58]:
```
plt.figure(figsize=(20,10))
sns.barplot(data = df, x = "channel", y = "ROI",  hue = "channel")
plt.title("ROI of Diffrent channels based on country")
plt.show()
```



In [60]:
```
plt.figure(figsize=(20,10))
```

```
sns.lineplot(data = df, x = "channel", y = "ROI",size = "country" , hue = "country", style = "country", markers=True, dashes=False)
plt.title("ROI of Diffrent channels based on country")
plt.show()
```



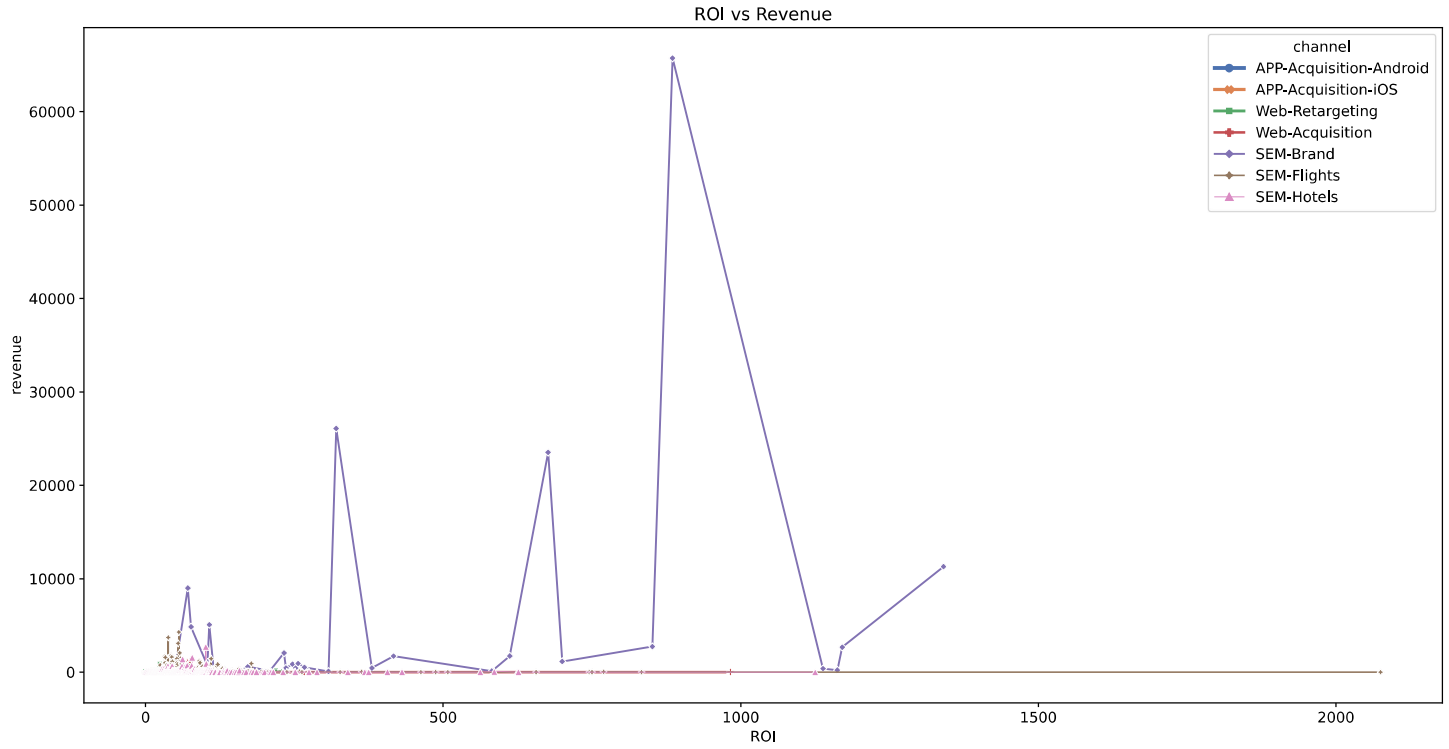
Based on above graph, we can see ROI of all countries are majorly contributed by

1. SEM Brand
2. SEM fligts
3. SEM Hotels
4. Web Retargeting

Additional graphs to understand distribution of ROI vs revenue & cost

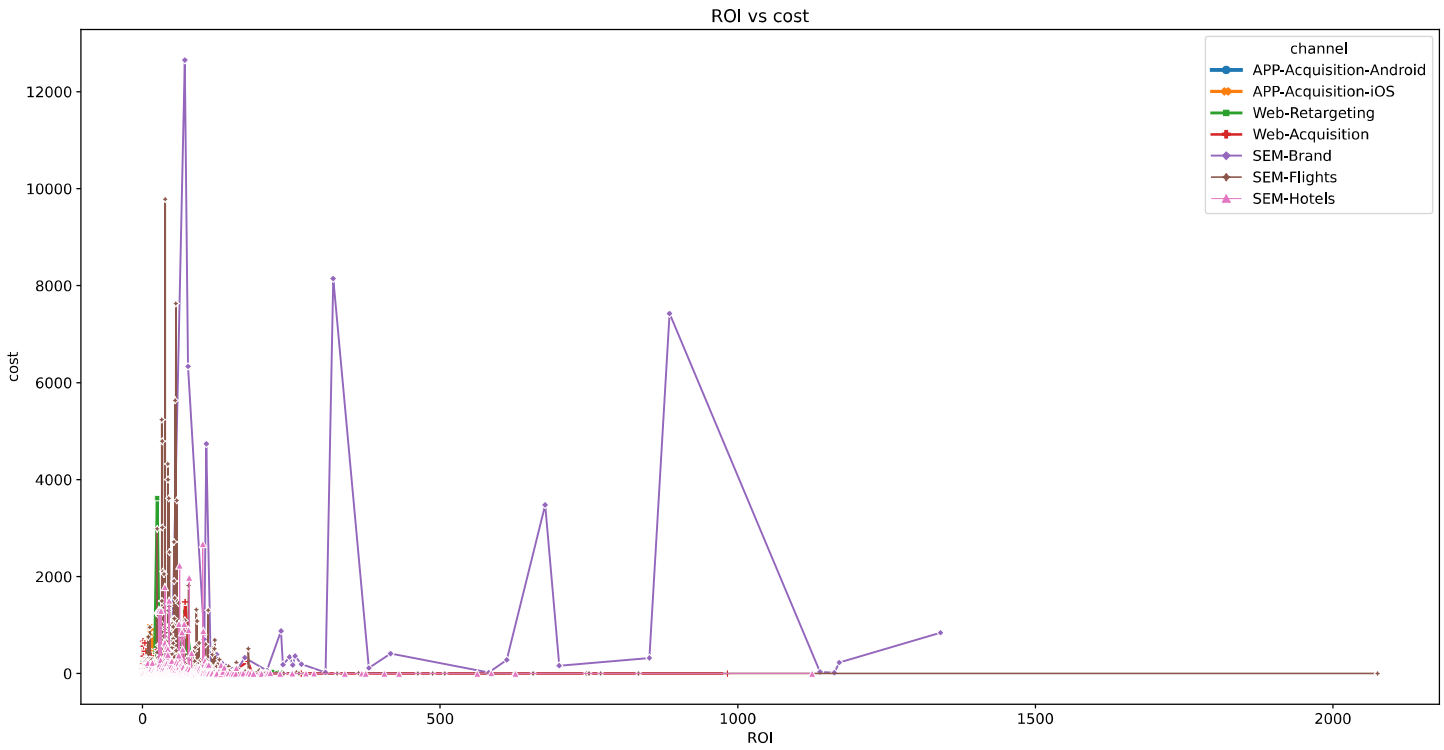
In [61]:

```
plt.figure(figsize=(20,10))
sns.lineplot(data = df, x = "ROI", y = "revenue", size = "channel", hue = "channel", palette= "deep", style = "channel", markers=True, dashes=False )
plt.title("ROI vs Revenue")
plt.show()
```



In [62]:

```
plt.figure(figsize=(20,10))
sns.lineplot(data = df, x = "ROI", y = "cost",size =  "channel", hue = "channel", style = "channel", markers=True, dashes=False)
plt.title("ROI vs cost")
plt.show()
```



3. What would you recommend our Digital Marketing team to do when they run online campaigns?

1. I would Recommend DM team to focus more on channels APP - Acqusition Android, APP - Acqusition IOS and Web retargetting, as they have higher clicks and purchases!, but with equivalent high cost of acqusition.

2. focusing of SEM brand,SEM flights and SEM hotel is also important as they have high contribution is ROI.

3. CPC is less for web Acqusition

4. CPI is more of IOS OS.