Heuristic 4

In [ ]:
```
#importing all the necessary libraries
import pickle
import random
import matplotlib.pyplot as plt
# open a file, where you stored the pickled data
file = open('carts', 'rb')
carts = pickle.load(file)
#carts-> dictionary key-> experiment no. [0,9] values-> list of lists
#key-> experiment no. and  value is list carts,
# print(carts)
```

In [21]:
```
file1 = open('prices', 'rb')
prices = pickle.load(file1)
#prices->dictionary key-> product no. [0-499], value-> random no. [100,1000]
# print(prices)
```

In [22]:
```
file2 = open('weights', 'rb')
weights = pickle.load(file2)
#weights -> dictionary key-> product no. [0-499], value-> random no. [0,2]
# print(weights)
```

In [23]:
```
file3 = open('f', 'rb')
f_vals = pickle.load(file3)
#The function f_val representsthe number of times item u has been purchased
# print(f_vals)
```

In [24]:
```
file4 = open('g', 'rb')
g_vals = pickle.load(file4)
#g_vals represents the number of times u and v areco-purchased.
```

In [25]:
```
file5 = open('adj_list', 'rb')
adj_lists = pickle.load(file5)
```

In [26]:
```
for e in range(10):
    rev=0
    for p in range(500):
        rev+=prices[p]*(f_vals[e][p])
        for n in adj_lists[e][p]:
            if n<p:
                rev+=(prices[p]*g_vals[e][(n,p)])
            else:
                rev+=(prices[p]*g_vals[e][(p,n)])
print(rev/10) # average revenue without changing price
```

```
542599.2461179008
```

In [38]:

```
delta_u=random.uniform(0,0.07) # selecting delta u from 0 to 0.07

revenues={}
updated_price={}
print("Value of delta u taken is ",delta_u)
delta_v=0 # delta v will be 0 as we are considering single item and not copu
for i in range(len(prices)):
    new_price=prices[i]*(1+delta_u) # price change for only one item at each
    updated_price[i]=new_price
    avg_revenue=0
    for exp in range(10): # calculating average revenue by performing 10 exp
        final_revenue=0
        new_f=f_vals[exp][i]*(1-delta_u) # f(u) changes to f'(u)=f(u) *(1 -
        sum_of_new_gvals=0
        for j in range(len(prices)):
            if (i,j) in g_vals[exp].keys():
                val=g_vals[exp].get((i,j))
            elif (j,i) in g_vals[exp].keys():
                val=g_vals[exp].get((j,i))
            new_g= val*(1-(weights[i]*delta_u)) # g(u,v) changes to g'(u, v)
            sum_of_new_gvals+=new_g
        final_revenue+=new_price*(new_f+sum_of_new_gvals)
        for item in range(len(prices)):
            if i!=item: #if new item is not equal to updated item then dont
                price=prices[item]
                f_val=f_vals[exp][item]
                sum_of_new_gvals=0
                for other_item in range(len(prices)):
                    if (item,other_item) in g_vals[exp].keys():
                        new_g1= g_vals[exp].get((item,other_item))
                    elif (other_item,item) in g_vals[exp].keys():
                        new_g1=g_vals[exp].get((other_item,item))
                    sum_of_new_gvals+=new_g1
                     # g(u,v) changes to g'(u, v) = g(u, v) * (1 - (w(u)*del
                final_revenue+=(price*(f_val+sum_of_new_gvals))
        avg_revenue+=final_revenue
    avg_revenue=avg_revenue/10 # calculating avg revenue over 10 experiments
    print("After changing price of item ", i, " the revenue is", avg_revenue
    revenues[i]=avg_revenue


```

```
After changing price of item  481  the revenue is 5483583.091367116
After changing price of item  482  the revenue is 5483804.343697489
After changing price of item  483  the revenue is 5483187.121071556
After changing price of item  484  the revenue is 5482940.768464057

After changing price of item  485  the revenue is 5481785.484930408
After changing price of item  486  the revenue is 5482944.0603627255
After changing price of item  487  the revenue is 5483010.61508172
After changing price of item  488  the revenue is 5482797.3469596
After changing price of item  489  the revenue is 5483279.29272156
After changing price of item  490  the revenue is 5484035.73219365
After changing price of item  491  the revenue is 5483075.738174282
After changing price of item  492  the revenue is 5483351.710744036
After changing price of item  493  the revenue is 5483149.923713776
```

```
After changing price of item  494  the revenue is 5483269.116715065
After changing price of item  495  the revenue is 5482240.575754886
After changing price of item  496  the revenue is 5483233.717294463
After changing price of item  497  the revenue is 5483115.558212538
After changing price of item  498  the revenue is 5482681.9454165315
After changing price of item  499  the revenue is 5482221.303966118
```

In [42]:

```
sorted_revenues=dict(sorted(revenues.items(), key=lambda item: item[1]))
# print("Items in decresing order of revenues: ",sorted_revenues)
revenue_list=[] # contains avg revenue by Ordering the items statically base
#that can achieved by varying respective item prices.
items_taken=[] #  items whose updated price is to be taken


count=0
for i in sorted_revenues.keys():
    items_taken.append(i)
#     print("updated price items taken are: ", items_taken)
    items_not_taken=[]  # items whose original price is to be taken
    for key in sorted_revenues.keys():
        if key not in items_taken:
            items_not_taken.append(key)
    avg_revenue1=0
    for exp in range(10):  # calculating average revenue by performing 10 ex
        final_revenue1=0
        for item1 in items_taken:
            price1=updated_price[item1]
#             f_val1=f_vals[exp][item1]*(1-delta_u)
            f_val1=f_vals[exp][item1]
            sum_of_new_gvals1=0
            for item2 in range(len(prices)):
                if (item1,item2) in g_vals[exp].keys():
                    new_g2=g_vals[exp].get((item1,item2))
                elif (item2,item1) in g_vals[exp].keys():
                    new_g2=g_vals[exp].get((item2,item1))
                sum_of_new_gvals1+=new_g2
            final_revenue1+=(price1*(f_val1+sum_of_new_gvals1))
        for item3 in items_not_taken:
            price2=prices[item3]
            f_val2=f_vals[exp][item3]
            sum_of_new_gvals2=0
            for item4 in range(len(prices)):
                if (item3,item4) in g_vals[exp].keys():
                    new_g3=g_vals[exp].get((item3,item4))
                elif (item4,item3) in g_vals[exp].keys():
                    new_g3=g_vals[exp].get((item4,item3))
                sum_of_new_gvals2+=new_g3
            final_revenue1+=(price2*(f_val2+sum_of_new_gvals2))
        avg_revenue1+=final_revenue1
    avg_revenue1=avg_revenue1/10
    print("Avg revenue after iteration ", count, " is", avg_revenue1)
    revenue_list.append(avg_revenue1)
    count+=1
    if count==200:
        break


```

```
Avg revenue after iteration  0  is 5484403.163234556
Avg revenue after iteration  1  is 5485555.649739991
Avg revenue after iteration  2  is 5486695.65434357
Avg revenue after iteration  3  is 5487887.549965242
Avg revenue after iteration  4  is 5489102.6884811055
```

```
Avg revenue after iteration  5  is 5490296.302359858
Avg revenue after iteration  6  is 5491337.375242835
Avg revenue after iteration  7  is 5492402.257934165
Avg revenue after iteration  8  is 5493462.227340499
Avg revenue after iteration  9  is 5494438.21570532
Avg revenue after iteration  10  is 5495509.266582765
Avg revenue after iteration  11  is 5496726.960519787
Avg revenue after iteration  12  is 5497962.507209001
Avg revenue after iteration  13  is 5499160.95478378
Avg revenue after iteration  14  is 5500202.724186351
Avg revenue after iteration  15  is 5501056.42278851
Avg revenue after iteration  16  is 5502138.460023467
Avg revenue after iteration  17  is 5503164.2594991755
Avg revenue after iteration  18  is 5504080.998803952
```

In [43]:
```
file_name = "revenue_h4.pkl"

# open_file = open(file_name, "wb")
# pickle.dump(revenue_list, open_file)
```

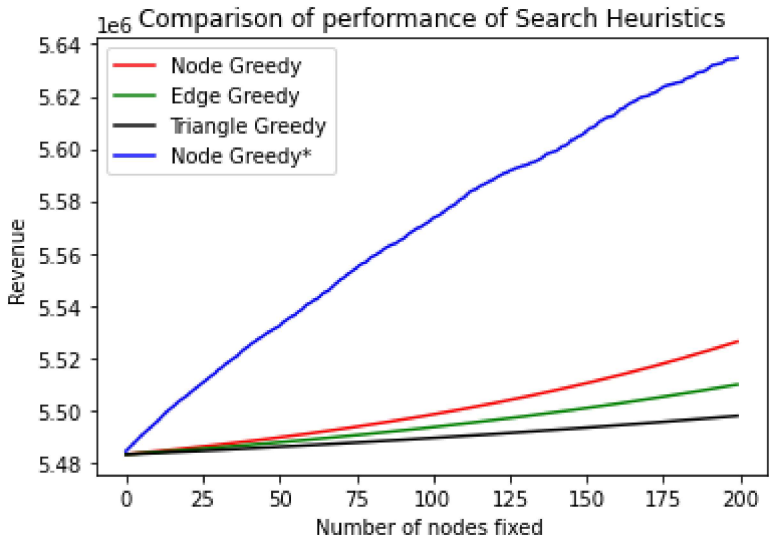
In [79]:
```
open_file = open(file_name, "rb")
final_revenue_list = pickle.load(open_file)

```

In [80]:
```
open_file1 = open("result_1_08", "rb")
final_revenue_list1 = pickle.load(open_file1)
```

In [81]:
```
open_file2 = open("result_12_52", "rb")
final_revenue_list2 = pickle.load(open_file2)
```

In [82]:
```
open_file3 = open("result", "rb")
final_revenue_list3 = pickle.load(open_file3)
```

In [85]:
```
1
2  x_axis=[]
3  for i in range(200):
4      x_axis.append(i)
5
6  plt.figure()
7  plt.title("Comparison of performance of Search Heuristics")
8  plt.xlabel("Number of nodes fixed ")
9  plt.ylabel("Revenue")
10 plt.plot(x_axis, final_revenue_list1,c='red',label='Node Greedy')
11 plt.plot(x_axis, final_revenue_list2,c='green',label='Edge Greedy')
12 plt.plot(x_axis, final_revenue_list3,c='black',label='Triangle Greedy')
13 plt.plot(x_axis, final_revenue_list,c='blue',label='Node Greedy*')
14 plt.legend()
15 plt.show()
```



In [ ]:
```
1
```