In [166]:
```
# Importing the required packages
import pandas as pd
import numpy as np
from matplotlib import pyplot as plt
import warnings
warnings.filterwarnings('ignore')
import calendar

%matplotlib inline
```

In [58]:
```
# Importing the requisite data
patients = pd.read_excel('Example_data.xlsx', sheet_name='patients_table')
activity = pd.read_excel('Example_data.xlsx', sheet_name='activity_table')

# Creating datetime object for the available dates
patients['Admit Date'] = pd.to_datetime(patients['Admit Date'])
patients['Discharge Date'] = pd.to_datetime(patients['Discharge Date'])
patients['Procedure Date'] = pd.to_datetime(patients['Procedure Date'])
```

In [59]:
```
# Understanding the patients data
patients.head(10)
```

Out[59]:

	MRN	Patient	Facility	Service Line	Admit Date	Discharge Date	Age	Phone	
0	2709468722	Uriel George	Plainsboro	Cardiovascular	2017-02-13	2017-02-23	44	652-2234	
1	2702696605	Kiara Barnett	Plainsboro	Orthopedics	2017-01-19	2017-01-27	59	279-6509	
2	3306518558	Denise Pate	Sacred Heart	Orthopedics	2017-07-04	2017-07-11	28	1-601-852-5086	i
3	2704682621	Solomon Alexander	Plainsboro	Orthopedics	2017-08-09	2017-08-12	19	394-2236	in.magna.Pha
4	2907030044	Blythe Pugh	Plainsboro	Orthopedics	2017-11-08	2017-11-18	27	298-8794	
5	3008263908	Ronan Haney	Sacred Heart	Orthopedics	2017-01-12	2017-01-15	30	1-736-451-1631	
6	3101205049	Amena Knapp	Sacred Heart	Orthopedics	2017-10-31	2017-11-06	54	1-162-735-9589	
7	2904316228	Noelle Strong	Plainsboro	Cardiovascular	2017-12-27	2017-12-30	46	1-703-379-4731	lacinia.or
8	2805281264	Ramona Meyers	Plainsboro	Maternity	2017-07-24	2017-08-02	60	1-620-603-4262	
9	2706380852	Dale Schmidt	Plainsboro	Orthopedics	2017-01-16	2017-01-23	44	405-1969	

```
In [25]: # Understanding the activity data
         activity.head(10)
```

Out[25]:

	Activity ID	MRN	Activity Type	Activity State
0	1007627836	2806749524	Onsite Visit	completed
1	1001527219	2906754150	Post-call	completed
2	1009050333	2808696322	Onsite Visit	completed
3	1008971483	2907357587	Post-call	completed
4	1002947186	2701436744	Pre-call	completed
5	1008673195	2906176068	Onsite Visit	missed
6	1004922945	2703911819	Pre-call	completed
7	1001946247	2706380852	Pre-call	missed
8	1002876267	3004148480	Pre-call	missed
9	1008487598	2806638348	Onsite Visit	completed

Excel Section

```
In [60]: # Question 1 : How many patient admittances are in the patients_table report?
         print ("Number of Patient Admittances = {}".format(patients['MRN'].count()))
```

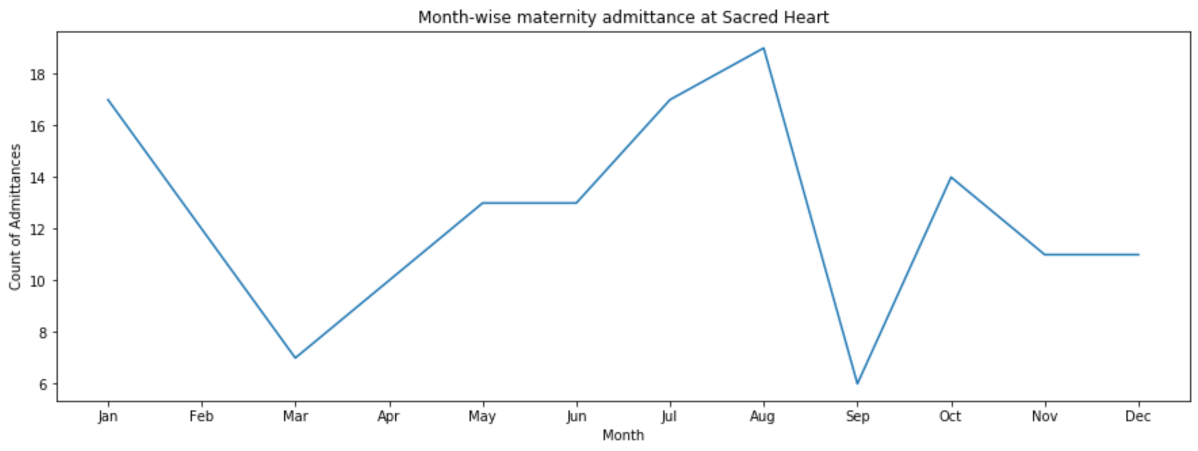
```
Number of Patient Admittances = 1374
```

```
In [146]: # Question 2 : How many maternity admittances were there at Sacred Heart in th
          e month of June?
          filter_sacred_heart = patients[patients['Facility']=='Sacred Heart']
          filter_sacred_heart_maternity = filter_sacred_heart[filter_sacred_heart['Servi
          ce Line'] == 'Maternity']
          # Creating the month column in the view
          filter_sacred_heart_maternity['month_number'] = filter_sacred_heart_maternity[
          'Admit Date'].dt.strftime('%m').astype('int')
          filter_sacred_heart_maternity_june = filter_sacred_heart_maternity[filter_sacr
          ed_heart_maternity['month_number'] == 6]
          print ("Maternity Admittance in June : {}".format(filter_sacred_heart_maternit
          y_june['MRN'].count()))
```

```
Maternity Admittance in June : 13
```

In [170]:
```
# Question 3 : What about the rest of the year? Build a line graph that shows
 how many maternity admittances there were at Sacred Heart, for each month of
 2017
yearly_count = filter_sacred_heart_maternity[['MRN', 'month_number']].groupby(
'month_number').size()\
                        .reset_index(name='count').sort_values('month_number',
ascending=True)['count']
months = [v for k,v in enumerate(calendar.month_abbr) if v !='']

plt.figure(figsize=(15, 5))
plt.plot(months, yearly_count)
plt.xlabel('Month')
plt.ylabel('Count of Admittances')
plt.title('Month-wise maternity admittance at Sacred Heart')
```

Out[170]:
```
Text(0.5, 1.0, 'Month-wise maternity admittance at Sacred Heart')
```



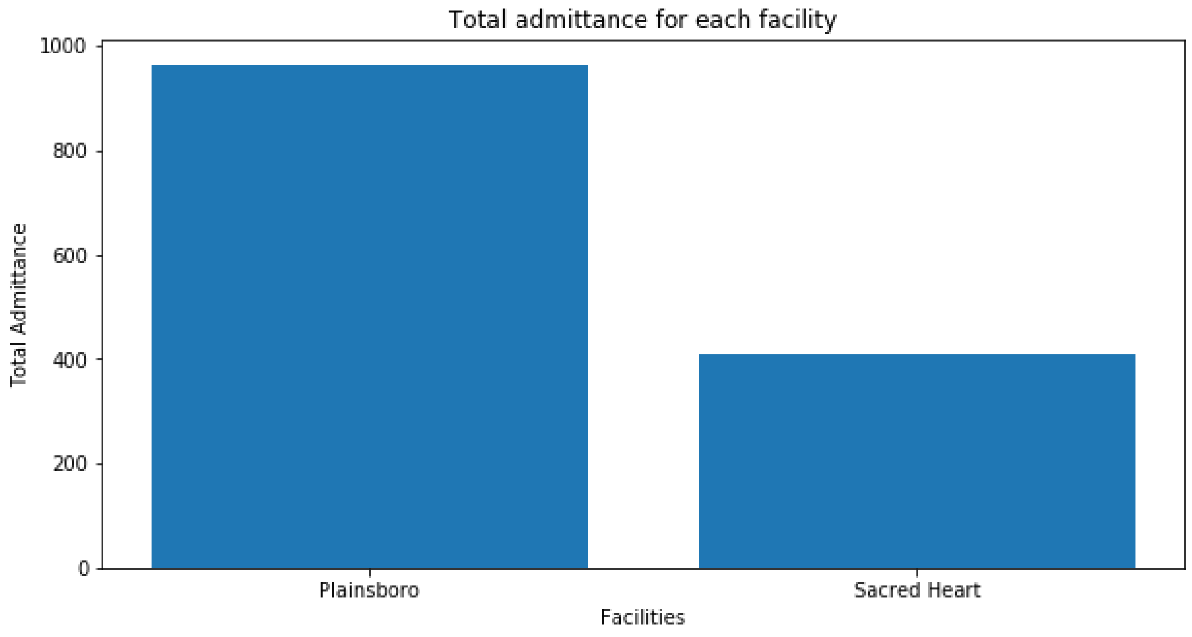
In [473]:
```
# Question 4 : Are there any patients who were admitted more than once to the
 same facility, in 2017?
# If so, list their MRNs here; if not, confirm that there aren't any.

join_patients_activity = pd.merge(patients[['MRN', 'Facility']], activity[['MR
N', 'Activity State']],
                                 on='MRN')
join_patients_activity_completed = join_patients_activity[join_patients_activi
ty['Activity State'] ==
                                                         'completed']
total_visits_per_patient = join_patients_activity_completed.groupby(['MRN', 'F
acility']).size().reset_index(name='count')
patients_admitted_multiple_times = total_visits_per_patient[total_visits_per_p
atient['count'] > 1]['MRN']
print ("All MRNs of patients with multiple visit history : \n")
print (list(patients_admitted_multiple_times[:20]))
```

```
All MRNs of patients with multiple visit history :

[2701153542, 2701181062, 2701378705, 2701394560, 2701436744, 2701479726, 2701
493934, 2701677385, 2701695323, 2701797584, 2701827612, 2701874608, 270200718
5, 2702010537, 2702047456, 2702083528, 2702088555, 2702176851, 2702201108, 27
02201396]
```

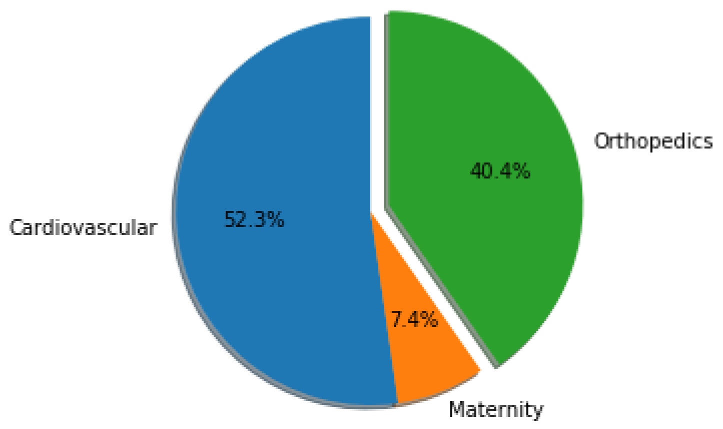
Tableau Section

In [254]:
```
# Question 1 : Build a bar chart that compares the total number of admittances
to Sacred Heart and Plainsboro
facility_view = patients[['MRN', 'Facility']].groupby('Facility').size().reset
_index(name='count')

plt.figure(figsize=(10, 5))
plt.bar(facility_view['Facility'], facility_view['count'])
plt.xlabel('Facilities')
plt.ylabel('Total Admittance')
plt.title('Total admittance for each facility')
```

Out[254]:
```
Text(0.5, 1.0, 'Total admittance for each facility')
```



In [273]:
```
# Question 2 : Build a pie chart, that compares the number of admittances for
 each service line at Plainsboro.
patients_plainsboro = patients[patients['Facility'] == 'Plainsboro']

patients_plainsboro_service_line = patients_plainsboro[['MRN', 'Service Line'
]].groupby('Service Line')\
                                    .size().reset_index(name='count')
_, ax = plt.subplots()
ax.pie(patients_plainsboro_service_line['count'], explode=(0, 0, 0.1),
        labels=patients_plainsboro_service_line['Service Line'], autopct='%1.1
f%%', shadow=True, startangle=90)
ax.axis('equal')
plt.show()
```



In [286]:
```
# Question 3 : How many patients did we complete exactly 3 activities with?
activity_completed = activity[activity['Activity State'] == 'completed'].group
by('MRN').size().reset_index(name='count')
activity_completed_thrice = activity_completed[activity_completed['count'] ==
3]
print ("Total patients with exactly 3 activities completed = {}".format(activi
ty_completed_thrice['MRN'].count()))
```

```
Total patients with exactly 3 activities completed = 131
```

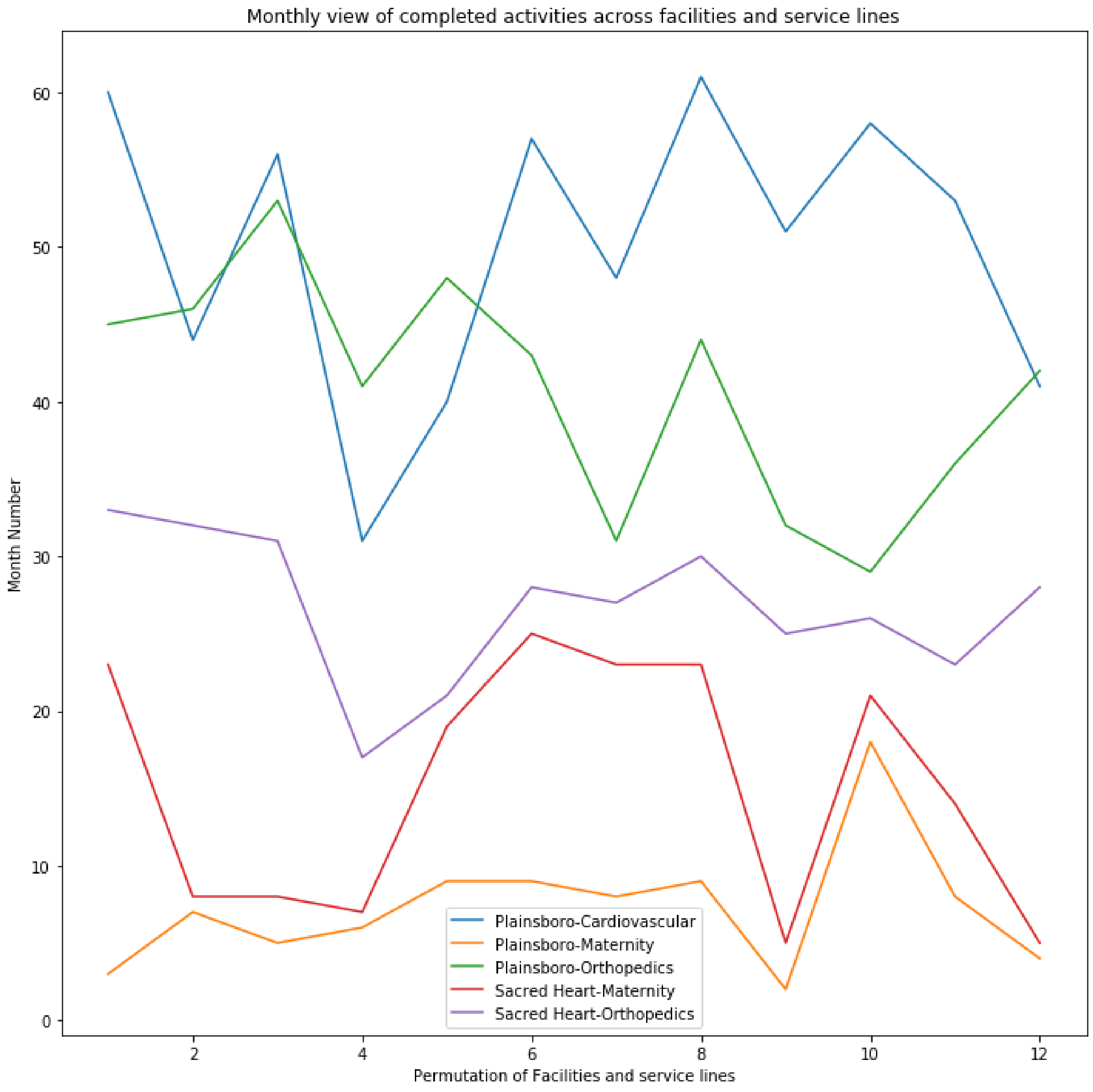
In [340]:
```
# Question 4 : What % of all activities (completed or missed) for orthopedic p
atients at Plainsboro are completed?
join_patients_activity = pd.merge(patients[['MRN', 'Facility', 'Service Line',
'Discharge Date']], activity[['MRN', 'Activity State']],
                                 on='MRN')
plainsboro_activity = join_patients_activity[join_patients_activity['Facility'
]=='Plainsboro']
plainsboro_activity_orthopedic = plainsboro_activity[plainsboro_activity['Serv
ice Line'] == 'Orthopedics']
plainsboro_activity_completed = plainsboro_activity_orthopedic[plainsboro_acti
vity_orthopedic['Activity State'] == 'completed']['MRN'].count() / plainsboro_
activity_orthopedic['MRN'].count()
print ("% of all activity for orthopedic patients at Plainsboro which are comp
leted = {:.4f}".format(plainsboro_activity_completed*100))
```

```
% of all activity for orthopedic patients at Plainsboro which are completed =
61.4806
```

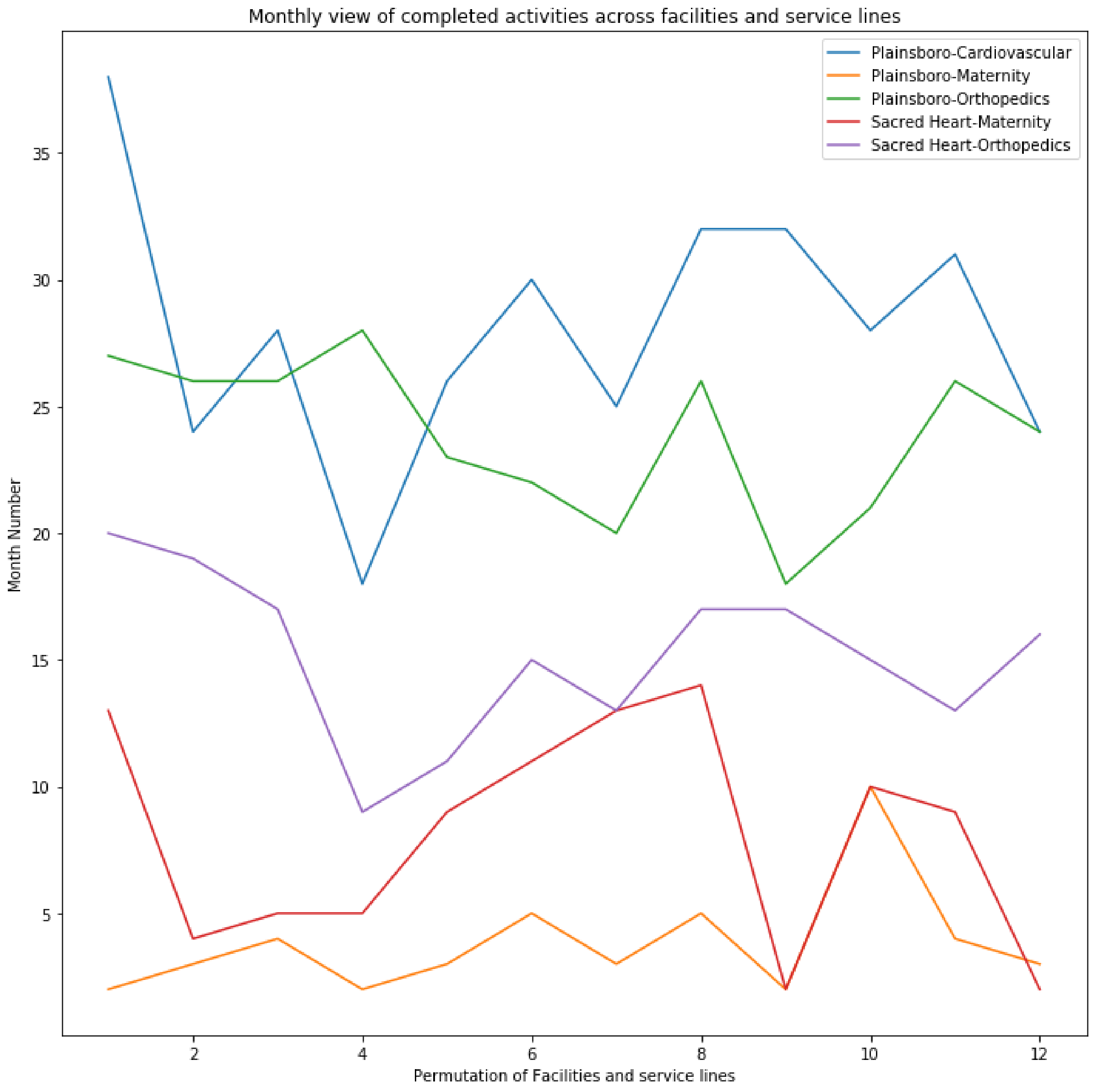
In [321]:
```
# Question 5 : Calculate the same for orthopedic patients at Sacred Heart. Wha
t's the difference between the two rates?
# Part - 1:
sacred_heart_activity = join_patients_activity[join_patients_activity['Facilit
y']=='Sacred Heart']
sacred_heart_activity_orthopedic = sacred_heart_activity[sacred_heart_activity
['Service Line'] == 'Orthopedics']
sacred_heart_activity_completed = sacred_heart_activity_orthopedic[sacred_hear
t_activity_orthopedic['Activity State'] == 'completed']['MRN'].count() / sacre
d_heart_activity_orthopedic['MRN'].count()
print ("Part1: % of all activity for orthopedic patients at Plainsboro which a
re completed = {:.4f}".format(sacred_heart_activity_completed*100))
print ("Part2: Difference between the two rates = {:.4f}".format(abs(sacred_he
art_activity_completed-plainsboro_activity_completed)*100))
```

```
Part1: % of all activity for orthopedic patients at Plainsboro which are comp
leted = 63.1890
Part2: Difference between the two rates = 1.7084
```

In [412]:
```
# Question 6 : Make a month-to-month line chart showing of the number of compl
eted activities, for each permutation of
# facility and service line
join_patients_activity['month_number'] = join_patients_activity['Discharge Dat
e'].dt.strftime('%m').astype('int')
join_patients_activity_completed = join_patients_activity[join_patients_activi
ty['Activity State']=='completed']
monthly_view = join_patients_activity_completed.groupby(['Facility', 'Service
 Line', 'month_number']).size()\
                   .reset_index(name='count').sort_values('month_number', asce
nding=True)
monthly_view['month_name'] = [months[item-1] for item in list(monthly_view['mo
nth_number'])]
monthly_view['permutation'] = monthly_view['Facility'] + '-' + monthly_view['S
ervice Line']
monthly_view_pivot = pd.pivot(monthly_view[['permutation', 'month_name', 'coun
t', 'month_number']],
                              index='month_number',
                              columns='permutation', values='count')
ax = monthly_view_pivot.plot(kind='line', figsize=(10, 10))
ax.legend(loc='best')
ax.set_ylabel('Month Number')
ax.set_xlabel('Permutation of Facilities and service lines')
ax.set_title('Monthly view of completed activities across facilities and servi
ce lines')
plt.tight_layout()
for p in ax.patches:
    if round(p.get_width(), 3) == 0.0:
        continue
    ax.text(p.get_width()*1.01, p.get_y()*1.01, str(round(p.get_width(), 3)))
```


Monthly view of completed activities across facilities and service lines
Month Number
Permutation of Facilities and service lines
0
10
20
30
40
50
60
2
4
6
8
10
12
Plainsboro-Cardiovascular
Plainsboro-Maternity
Plainsboro-Orthopedics
Sacred Heart-Maternity
Sacred Heart-Orthopedics

In [417]:
```
# Question 7: Replicate what you've made in (6), but scope the chart to only c
onsider the first activity that is completed by a patient, filtering out any s
ubsequent ones.
join_patients_activity_completed = join_patients_activity_completed.drop_dupli
cates(subset=['MRN'], keep='first')
monthly_view = join_patients_activity_completed.groupby(['Facility', 'Service
 Line', 'month_number']).size()\
                   .reset_index(name='count').sort_values('month_number', asce
nding=True)
monthly_view['month_name'] = [months[item-1] for item in list(monthly_view['mo
nth_number'])]
monthly_view['permutation'] = monthly_view['Facility'] + '-' + monthly_view['S
ervice Line']
monthly_view_pivot = pd.pivot(monthly_view[['permutation', 'month_name', 'coun
t', 'month_number']],
                              index='month_number',
                              columns='permutation', values='count')
ax = monthly_view_pivot.plot(kind='line', figsize=(10, 10))
ax.legend(loc='best')
ax.set_ylabel('Month Number')
ax.set_xlabel('Permutation of Facilities and service lines')
ax.set_title('Monthly view of completed activities across facilities and servi
ce lines')
plt.tight_layout()
for p in ax.patches:
    if round(p.get_width(), 3) == 0.0:
        continue
    ax.text(p.get_width()*1.01, p.get_y()*1.01, str(round(p.get_width(), 3)))
```



Logic Portion

In [470]:
```
final_results = []
final_results.append({'P':'P', 'Q':'Q', '~P':'~P', '~Q':'~Q', '~P V Q':'~P V
 Q', 'P ^ ~Q':'P ^ ~Q',
     '~(P V Q)': '~(P V Q)', '~P V ~Q': '~P V ~Q', '~P V (P ^ ~Q)': '~P V (P
 ^ ~Q)'})

dict_keys = ['P', 'Q', '~P', '~Q', '~P V Q', 'P ^ ~Q', '~(P V Q)', '~P V ~Q',
'~P V (P ^ ~Q)']
res_vals = [
    ['T', 'T', 'F', 'F', 'T', 'F', 'F', 'F', 'F'],
    ['T', 'F', 'F', 'T', 'F', 'T', 'F', 'T', 'T'],
    ['F', 'T', 'T', 'F', 'T', 'F', 'F', 'T', 'T'],
    ['F', 'F', 'T', 'T', 'T', 'F', 'T', 'T', 'T']
]

for row in res_vals:
    tmp_dict = {}
    for idx in range(len(row)):
        tmp_dict[dict_keys[idx]] = row[idx]
    final_results.append(tmp_dict)
print (tabulate(final_results))
```

```
-  -  --  --  ------  ------  --------  -------  -------------
P  Q  ~P  ~Q  ~P V Q  P ^ ~Q  ~(P V Q)  ~P V ~Q  ~P V (P ^ ~Q)
T  T  F   F   T       F       F         F        F
T  F  F   T   F       T       F         T        T
F  T  T   F   T       F       F         T        T
F  F  T   T   T       F       T         T        T
-  -  --  --  ------  ------  --------  -------  -------------
```