AIR TRANSPORT EXERCISE REPORT

SAPIENZA
UNIVERSITÀ DI ROMA

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Rehabilitating of Falconara Airport

About Falconara Airport:

Falconara Airport is a small international airport located half way down the east coast of Italy, 18 km west of Ancona. LIPY is the only international airport of le Marche region. In 2013 it had a traffic of ~500 000 passengers and ~6 600 tons of goods. It has two separate terminals for arrival/departure of passengers and another cargo terminal area. The control tower is powered by a photovoltaic system. It has an unused military area and hosts 5º Nucleo Elicotteri of the Carabinieri, with an Agusta A109 helicopter.In 1981 the airport was visited by a Concorde. During the various operations in the Balcans area, for its obvious favorable position, it has been used by military forces with Apaches, UH-60, tankers, A-10, Harriers, and heavy cargos like C-17, C-5, An-124.

A peculiarity of this airport is that 1 km north of it, right on the coast, there is a refinery that can't be overflown.

Structure:

The only runway, 04/22, is almost 3 km long, 45 m wide, and it's used also for taxiing, as the taxiway parallel to the runway is off duty. It's used in both directions but only 22 is served by ILS. It has a 0.2% slope towards north-east.

The main apron is located towards the southwest end of the runway. It has 14 parking places, four of which for smaller planes, and the main taxiways are R1 and R2. R3 connects the middle of the runway to the aeroclub and private hangars.

No operations area is present for civil helicopters, that need to take off and land on the runway.

Class project 1

Travel Time Threshold- TTT Calculations

determine:

Travel Time Thresholds – TTT
(travel time required by passenger car to reach the destination);
TTTs: 30 min.; 1h; 1h30min; 2h; >2h
Catchment Areas – CA

- report them into a Matrix and by isochrones on a map
Origin: each municipality of the ANCONA province
(https://www.tuttitalia.it/marche/provincia-di-ancona/)

Destination: a) Falconara Airport; b) Firenze (Florence) Airport; c) Rimini Airport, d) Bologna Airport, e) Pescara Airport

Solution:

First of all we need to do is study 5 airports, compare the timings that we need to reach from all the origin points of Ancona province to the these destination airports and then project it on to the map that is shown below:

Firstly, we have to calculate the travel time required by passengers to reach the destination airport from the municipalities nearby it. We are now calculating the time required for each Municipalities to reach the 5
Airports (Falconara, Pescara, Rimini, Bologna, Florence) in Minutes.

We use GOOGLE MAP to calculate the travel time and filled the matrix. The travel time in the matrix are classified into groups as indicated below:

t >30 min	
31min>t>60 min	
61min>t>90 min	
91min>t>120 min	
t >121 min	

The following table is the timing in minutes of different origins from Ancona province to all the 5 airports which are shown as per the colour coding scheme.

COD_Province	COD_Municipality	NAME_Municipality	FALCONARA AIRPORT	PESCARA AIRPORT	RIMINI AIRPORT	BOLOGNA AIRPORT	FLORENCE AIRPORT
42	042001	Agugliano	12	114	64	128	186
42	042002	Ancona	23	111	71	136	194
42	042003	Arcevia	52	153	79	143	170
42	042004	Barbara	36	141	65	128	187
42	042005	Belvedere Ostrense	22	129	60	125	183
42	042006	Camerano	21	111	68	132	192
42	042007	Camerata Picena	6	115	55	120	178
42	042008	Castelbellino	23	127	69	133	173
42	042009	Castelfidardo	26	107	74	138	198
42	042011	Castelleone di Suasa	39	143	64	128	186
42	042012	Castelplanio	24	130	74	138	171
42	042013	Cerreto d'Esi	39	146	88	155	155
42	042014	Chiaravalle	6	116	56	120	181
42	042015	Corinaldo	32	137	58	122	182
42	042016	Cupramontana	25	132	75	140	175
42	042017	Fabriano	45	153	95	162	151
42	042018	Falconara Marittima	8	118	61	125	184
42	042019	Filottrano	26	123	76	141	193
42	042020	Genga	45	153	95	163	166
42	042021	Jesi	17	122	65	129	181
42	042022	Loreto	27	101	75	140	199
42	042023	Maiolati Spontini	27	129	73	138	176
42	042024	Mergo	28	134	77	144	172
42	042025	Monsano	14	121	63	128	185
42	042026	Montecarotto	29	135	72	138	180
42	042027	Montemarciano	13	118	55	119	178
42	042029	Monte Roberto	21	128	71	135	174
42	042030	Monte San Vito	11	120	59	123	182
42	042031	Morro d'Alba	19	129	59	124	183

42	042032	Numana	28	111	76	144	201
42	042033	Offagna	22	115	71	137	195
42	042034	Osimo	26	119	77	143	200
42	042035	Ostra	26	134	57	126	181
42	042036	Ostra Vetere	33	137	61	126	184
42	042037	Poggio San Marcello	29	137	79	146	176
42	042038	Polverigi	15	117	67	131	190
42	042040	Rosora	28	135	77	144	172
42	042041	San Marcello	19	127	64	93	188
42	042042	San Paolo di Jesi	21	129	70	137	178
42	042043	Santa Maria Nuova	19	124	79	134	186
42	042044	Sassoferrato	51	159	90	157	157
42	042045	Senigallia	19	124	48	113	172
42	042046	Serra de' Conti	34	141	66	131	184
42	042047	Serra San Quirico	31	137	81	147	172
42	042048	Sirolo	27	113	76	142	199
42	042049	Staffolo	25	132	75	140	182
42	042050	Trecastelli	28	131	54	118	178

Isochrones:

After the determination of travel time, the municipalities have been on map to draw catchment areas. Catchment areas have been drawn with respect to travel time threshold (TTT). Those are 0-30 mins, 31-60 mins, 61-90 mins, 91-120 mins and above 120 mins. Municipalities which have same threshold have been marked with same colour lines and created isochronoes. This process is repeated for each airport.

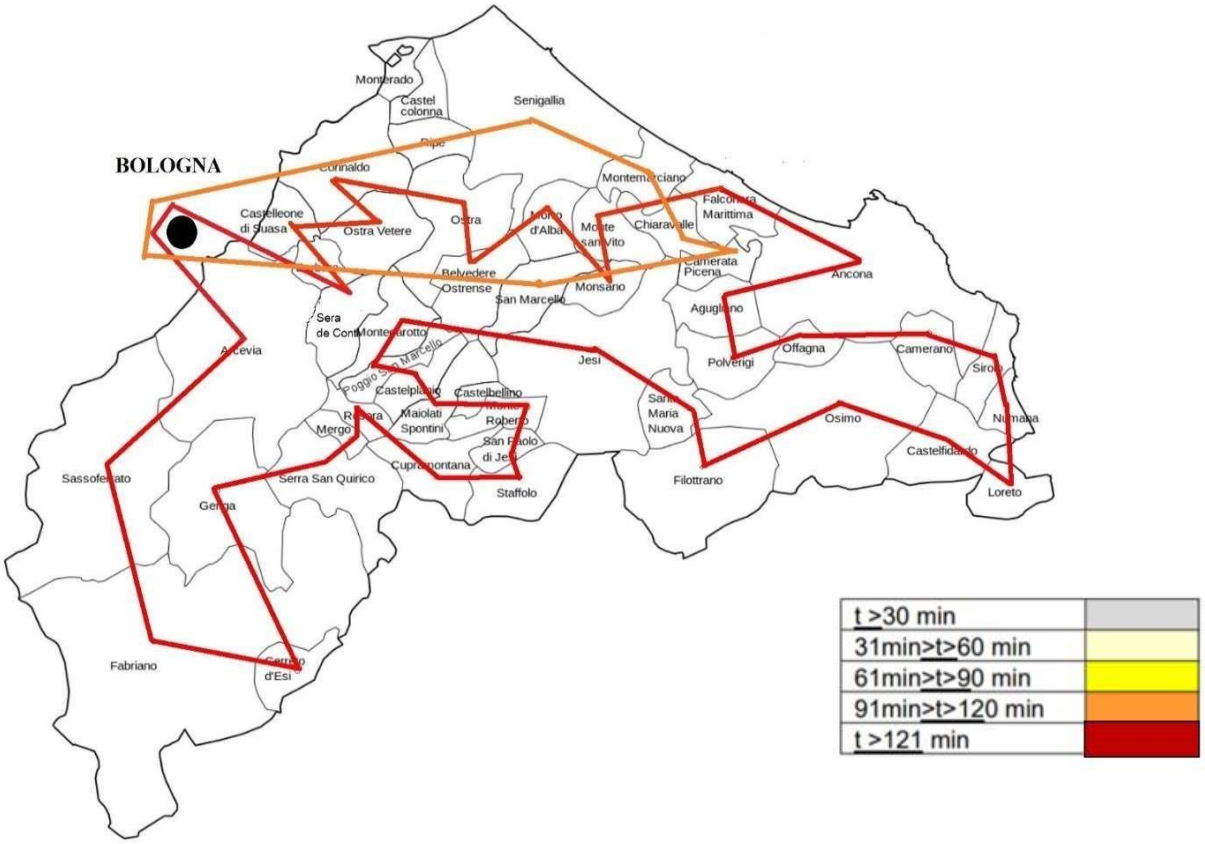
(1) FALCONARA AIRPORT

t >30 min	
31min>t>60 min	
61min>t>90 min	
91min>t>120 min	
t >121 min	

- The grey colour shows the municipalities which took less than 30 minutes to reach the airport.
- The cream colour shows areas which took 31-60 minutes to reach the airport.

Almost all the areas of Ancona province are accessible within 60 minutes.

(2) BOLOGNA AIRPORT

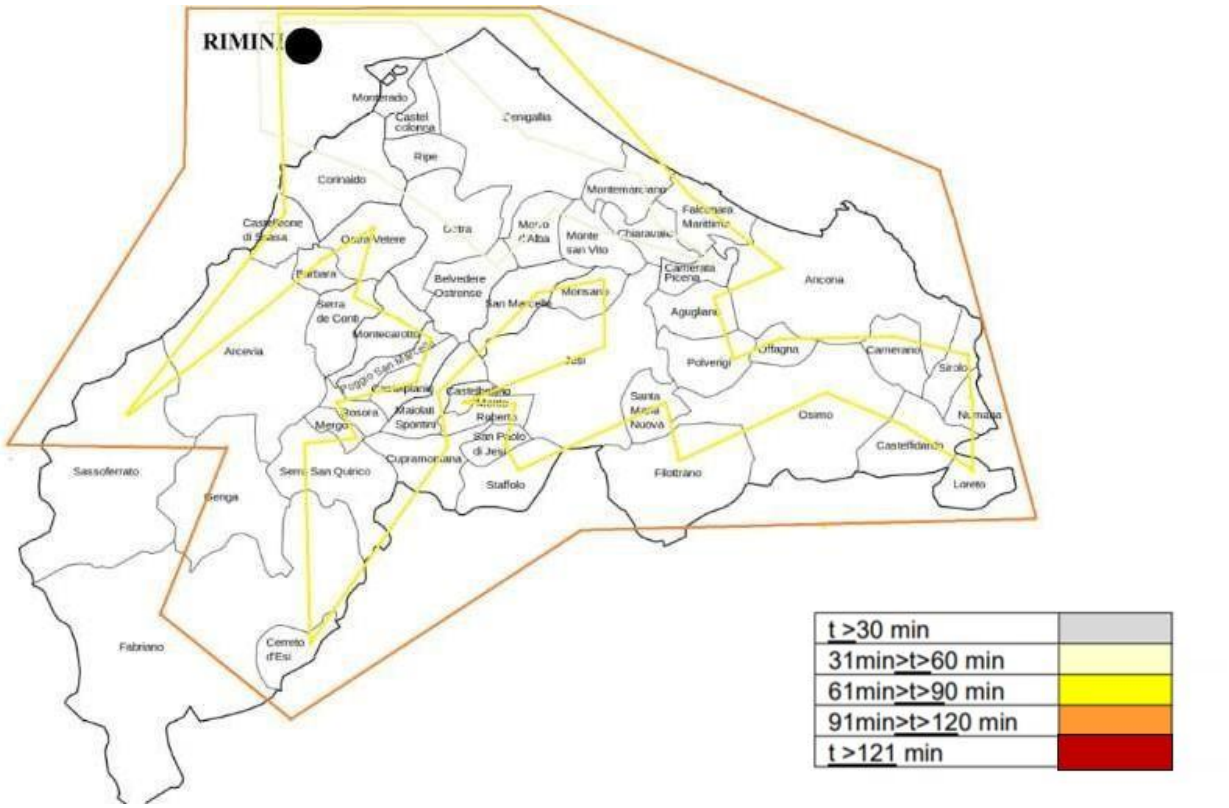


❖ The red line is connected with the areas which took more than 121 minutes to reach the airport.

❖ The orange line shows the areas which took 91-120 minutes to reach the airport.

For reaching the BOLOGNA airport from all the areas of Ancona Province it takes more than at least 90 minutes.

(3) RIMINI AIRPORT

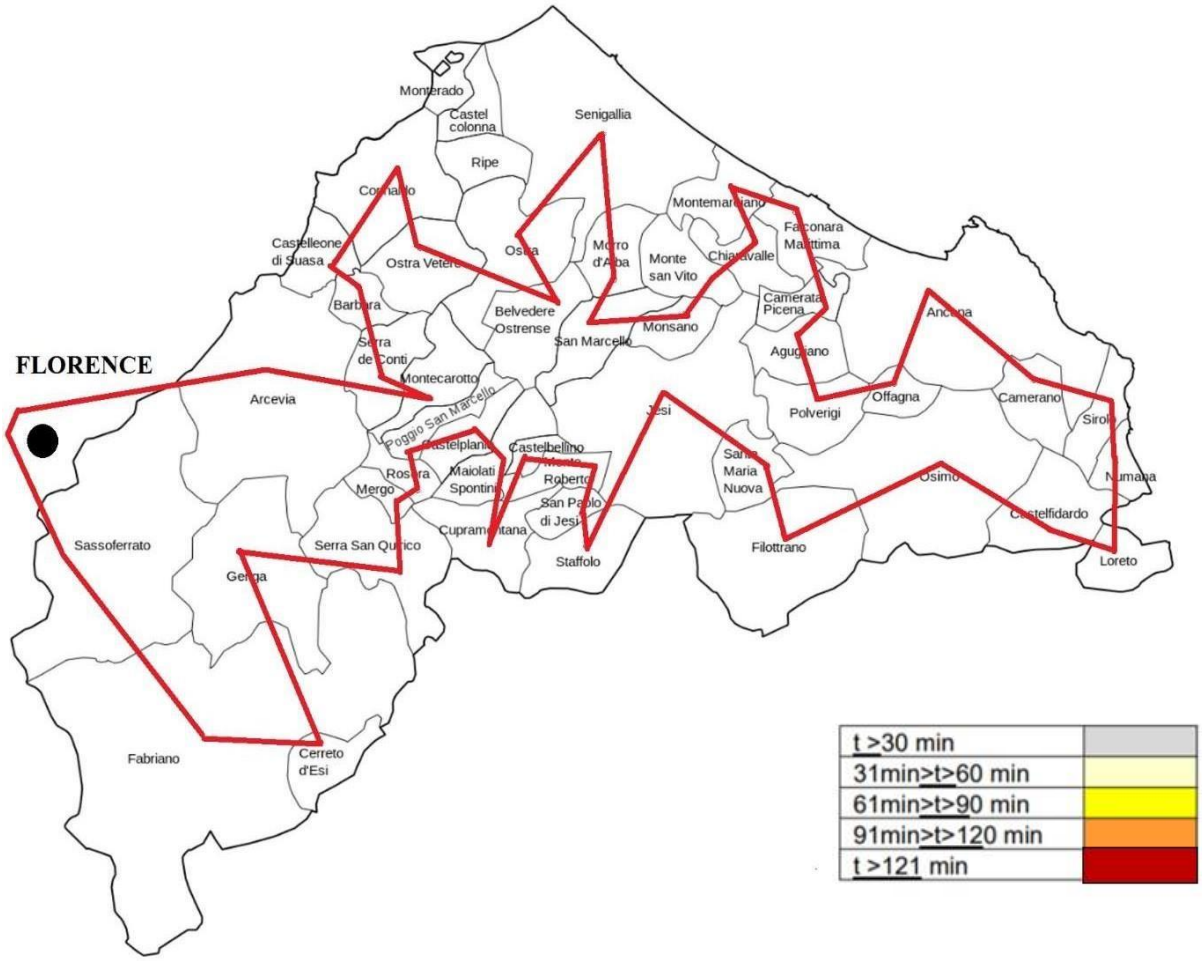


❖ The light red line is connected with the areas which took 90-120 minutes to reach the airport

❖ The yellow line shows the areas which took 61-90 minutes to reach the airport

For reaching the RIMINI airport we need time ranging from 30 – 120 minutes.

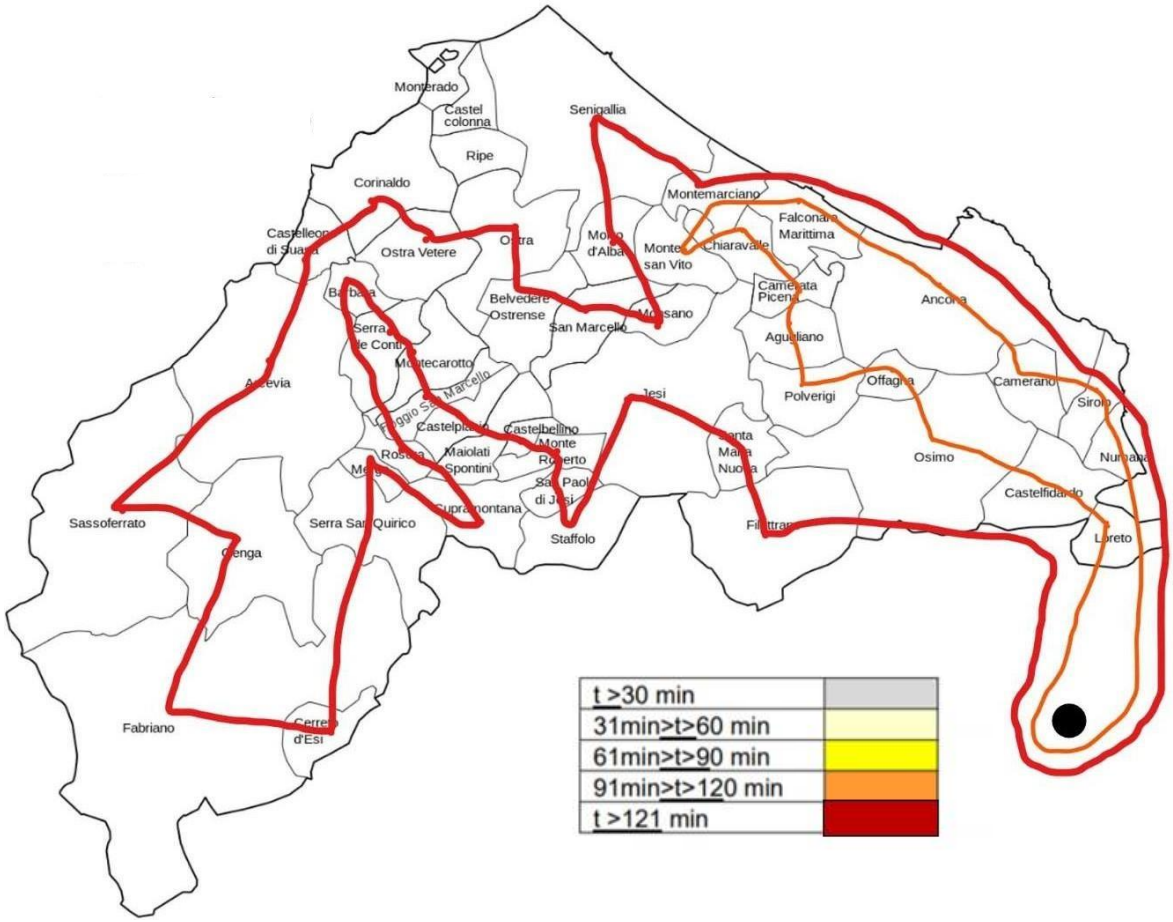
(4) FLORENCE AIRPORT



❖ The red line is connected with the areas which took more than 120 minutes to reach the airport

All the points from the points are very far from the FLORENCE airport, will consume at least 120 minutes to reach the airport.

(5) PESCARA AIRPORT



- The red line is connected with the areas which took less than 121 minutes to reach the airport.
- The orange line shows the areas which took 91-120 minutes to reach the airport.

Reaching Pescara Airport will need more than 90 minutes from any part of Ancona.

Exercise: 2

Associate with each TTT the related amount of population

Website to use:

Population stats available on demo.Istat (http://demo.istat.it/)

Assess population variation to create demand scenarios

Origin: each municipality of the Ancona province

Destination: a) Falconara Airport; b) Firenze (Florence) Airport; c) Rimini

Airport, d) Bologna Airport, e) Pescara Airport.

Solution:

Estimation of potential demand:

Now with the determination of TTT, we can associate it with the population of the cities of the study area. In the last part what we found the time that is required for reaching the 5 airports from all the origin points of the Ancona Province. Now, let us go a step forward by associating the population of all the origin points of Ancona Province with the time that we need to reach the airport (TTT). In this part we found the population of each municipality in the Ancona Province.

For that we have to categorize the population in age categories for a better study.

Categories in 3 different age groups such as:-
1. Total Population
2.Between 26-65 years,
3.More than 65 years.

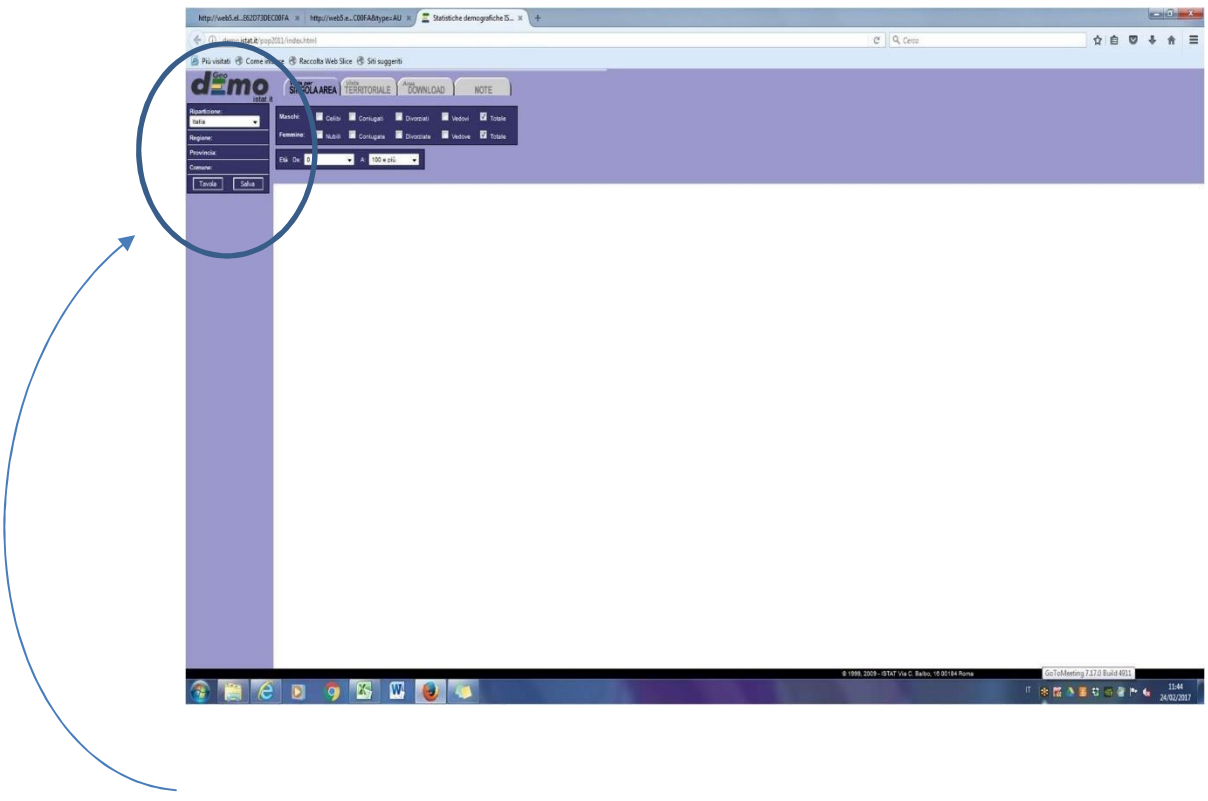
Data is collected for the years of 2011, 2019.

Population stats available on demo.Istat (http://demo.istat.it/)
http://demo.istat.it/pop2011/index.html

All we need to do is to go on to the website and

To start, select:

Area	Italia Centrale
Region	Marche
Province	Ancona then repeat with



We can go on to give the name of the origin point one by one and get the detail of the population and then depict in a tabularized manner as shown below.

In the table below we can see the population data for the mentioned cities and the data is classified as the population of 2011-2019 with the age classes as 25-65 years old and beyond 65 years old.

Population figures for 2011:

COD_Province	COD_Municipality	NAME_Municipality	Tot. Population 2011 (inh)	Population 26-65 2011 (inh)	Population >65 2011 (inh)
42	042001	Agugliano	4820	2752	773
42	042002	Ancona	102997	56186	23670
42	042003	Arcevia	5022	2551	1482
42	042004	Barbara	1482	791	330
42	042005	Belvedere Ostrense	2299	1199	558
42	042006	Camerano	7268	3990	1484
42	042007	Camerata Picena	2369	1411	338
42	042008	Castelbellino	4858	2840	727
42	042009	Castelfidardo	18935	10472	3543
42	042011	Castelleone di Suasa	1731	882	417
42	042012	Castelplanio	3552	1951	755
42	042013	Cerreto d'Esi	4009	2214	678
42	042014	Chiaravalle	15036	8338	3343
42	042015	Corinaldo	5152	2709	1297
42	042016	Cupramontana	4929	2568	1205
42	042017	Fabriano	31971	17454	7093
42	042018	Falconara marittima	27781	15056	6439
42	042019	Filottrano	9745	5280	2032
42	042020	Genga	1973	1082	489
42	042021	Jesi	40635	21975	9611
42	042022	Loreto	12543	6767	2741
42	042023	Maiolati Spontini	6199	3472	1251
42	042024	Mergo	1098	569	226
42	042025	Monsano	3271	1920	547
42	042026	Montecarotto	2083	1082	544
42	042027	Montemarciano	10236	5914	1893
42	042029	Monte Roberto	3021	1742	496
42	042030	Monte San Vito	6666	3728	1240
42	042031	Morro d'Alba	1970	1054	426
42	042032	Numana	3875	2257	782

42	042033	Offagna	1895	1087	348
42	042034	Osimo	33737	18722	6401
42	042035	Ostra	6837	3649	1483
42	042036	Ostra Vetere	3485	1868	799
42	042037	Poggio San Marcello	772	395	192
42	042038	Polverigi	4325	2552	621
42	042040	Rosora	1952	1068	429
42	042041	San Marcello	2093	1174	428
42	042042	San Paolo di Jesi	916	474	227
42	042043	Santa Maria Nuova	4263	2303	861
42	042044	Sassoferrato	7595	4065	1813
42	042045	Senigallia	45027	24904	10223
42	042046	Serra de' Conti	3741	2009	793
42	042047	Serra San Quirico	3036	1645	747
42	042048	Sirolo	3885	2215	827
42	042049	Staffolo	2372	1240	544
42	042050	Trecastelli	4371	2481	734

As we have now found out the population of the year 2011 category wise, similar approach will be followed for 2019. The table is shown below.

Population figures for 2019:

COD_Province	COD_Municipality	NAME_Municipality	Tot. Population 2019 (inh)	Population 26-65 2019 (inh)	Population >65 2019 (inh)
42	042001	Agugliano	4733	2621	935
42	042002	Ancona	101043	53486	25013
42	042003	Arcevia	4408	2222	1404
42	042004	Barbara	1327	687	350
42	042005	Belvedere Ostrense	2181	1147	545
42	042006	Camerano	7125	3776	1607
42	042007	Camerata Picena	2558	1477	421
42	042008	Castelbellino	5044	2866	891
42	042009	Castelfidardo	18683	10153	3840
42	042011	Castelleone di Suasa	1588	833	408
42	042012	Castelplanio	3446	1812	783
42	042013	Cerreto d'Esi	3650	1965	776
42	042014	Chiaravalle	14733	7736	3640
42	042015	Corinaldo	4927	2538	1310
42	042016	Cupramontana	4578	2365	1209
42	042017	Fabriano	30509	16159	7443

42	042018	Falconara marittima	25906	13304	7036
42	042019	Filottrano	9298	4978	2086
42	042020	Genga	1708	865	505
42	042021	Jesi	39969	21048	9924
42	042022	Loreto	12786	6816	2910
42	042023	Maiolati Spontini	6203	3291	1494
42	042024	Mergo	1013	557	228
42	042025	Monsano	3350	18483	682
42	042026	Montecarotto	1913	984	517
42	042027	Montemarciano	9873	5493	2168
42	042029	Monte Roberto	3057	1652	592
42	042030	Monte San Vito	6815	3784	1357
42	042031	Morro d'Alba	1854	970	450
42	042032	Numana	3795	2195	887
42	042033	Offagna	2025	1075	430
42	042034	Osimo	35007	18993	7245
42	042035	Ostra	6666	3556	1527
42	042036	Ostra Vetere	3234	1638	877
42	042037	Poggio San Marcello	671	361	153
42	042038	Polverigi	4552	2616	773
42	042040	Rosora	1950	1041	447
42	042041	San Marcello	2008	1121	448
42	042042	San Paolo di Jesi	916	485	225
42	042043	Santa Maria Nuova	4097	2158	956
42	042044	Sassoferrato	7070	3663	1866
42	042045	Senigallia	44620	23905	11043
42	042046	Serra de' Conti	3737	1954	868
42	042047	Serra San Quirico	2759	1416	738
42	042048	Sirolo	4063	2216	932
42	042049	Staffolo	2211	1209	508
42	042050	Trecastelli	7569	4237	1484

Now that we have found out the figure of both the years, let us analyze the numbers by studying the difference and what we will do is that we will allot some color coding also. For the area where there is decrease in population, we will mark it with pink and where there is increment, we will code it with green.

Then we found the difference in population of 2019 and 2011

COD_Province	COD Municipality	NAME Municipality	Tot. Population 2011 (inh)	Population 26-65 2011 (inh)	Population >65 2011 (inh)	Tot. Population 2019 (inh)	Population 26-65 2019 (inh)	Population >65 2019 (inh)	Total difference 2019-2011 (inh)	Total variation 2019-2011 (%)	Difference pop. 26-65 2019-2011 (inh)	Variation pop. 26-65 2019-2011 (%)	Difference pop. >65 2019-2011 (inh)	Variation pop. >65 2019-2011 (%)
42	042001	Agugliano	4820	2752	808	4733	2621	994	-87	-1.80%	-131	-4.76%	186	23.02%
42	042002	Ancona	102997	56186	24833	101043	53486	26287	-1954	-1.90%	-2700	-4.81%	1454	5.86%
42	042003	Arcevia	5022	2551	1531	4408	2222	1486	-614	-12.23%	-329	-12.90%	-45	-2.94%
42	042004	Barbara	1482	791	351	1327	687	371	-155	-10.46%	-104	-13.15%	20	5.70%
42	042005	Belvedere Ostrense	2299	1199	579	2181	1147	564	-118	-5.13%	-52	-4.34%	-15	-2.59%
42	042006	Camerano	7268	3990	1552	7125	3776	1697	-143	-1.97%	-214	-5.36%	145	9.34%
42	042007	Camerata Picena	2369	1411	354	2558	1477	443	189	7.98%	66	4.68%	89	25.14%
42	042008	Castelbellino	4858	2840	776	5044	2866	940	186	3.83%	26	0.92%	164	21.13%
42	042009	Castelfidardo	18935	10472	3721	18683	10153	4072	-252	-1.33%	-319	-3.05%	351	9.43%
42	042011	Castelleone di Suasa	1731	882	431	1588	833	426	-143	-8.26%	-49	-5.56%	-5	-1.16%
42	042012	Castelplanio	3552	1951	793	3446	1812	825	-106	-2.98%	-139	-7.12%	32	4.04%
42	042013	Cerreto d'Esi	4009	2214	715	3650	1965	812	-359	-8.95%	-249	-11.25%	97	13.57%
42	042014	Chiaravalle	15036	8338	3517	14733	7736	3803	-303	-2.02%	-602	-7.22%	286	8.13%
42	042015	Corinaldo	5152	2709	1356	4927	2538	1372	-225	-4.37%	-171	-6.31%	16	1.18%
42	042016	Cupramontana	4929	2568	1263	4578	2365	1265	-351	-7.12%	-203	-7.90%	2	0.16%
42	042017	Fabriano	31971	17454	7393	30509	16159	7824	-1462	-4.57%	-1295	-7.42%	431	5.83%
42	042018	Falconara Marittima	27781	15056	6756	25906	13304	7351	-1875	-6.75%	-1752	-11.64%	595	8.81%
42	042019	Filottrano	9745	5280	2116	9298	4978	2210	-447	-4.59%	-302	-5.72%	94	4.44%
42	042020	Genga	1973	1082	511	1708	865	522	-265	-13.43%	-217	-20.06%	11	2.15%
42	042021	Jesi	40635	21975	10064	39969	21048	10354	-666	-1.64%	-927	-4.22%	290	2.88%
42	042022	Loreto	12543	6767	2879	12786	6816	3045	243	1.94%	49	0.72%	166	5.77%
42	042023	Maiolati Spontini	6199	3472	1317	6201	3291	1577	2	0.03%	-181	-5.21%	260	19.74%
42	042024	Mergo	1098	569	235	1013	557	237	-85	-7.74%	-12	-2.11%	2	0.85%
42	042025	Monsano	3271	1920	579	3350	1843	715	79	2.42%	-77	-4.01%	136	23.49%
42	042026	Montecarotto	2083	1082	572	1913	984	543	-170	-8.16%	-98	-9.06%	-29	-5.07%
42	042027	Montemarciano	10236	5941	2002	9873	5493	2284	-363	-3.55%	-448	-7.54%	282	14.09%
42	042029	Monte Roberto	3021	1742	520	3059	1652	618	38	1.26%	-90	-5.17%	98	18.85%
42	042030	Monte San Vito	6666	3728	1296	6815	3784	1440	149	2.24%	56	1.50%	144	11.11%
42	042031	Morro d'Alba	1970	1054	445	1854	970	464	-116	-5.89%	-84	-7.97%	19	4.27%
42	042032	Numana	3875	2257	834	3795	2195	933	-80	-2.06%	-62	-2.75%	99	11.87%
42	042033	Offagna	1895	1087	367	2025	1075	463	130	6.86%	-12	-1.10%	96	26.16%
42	042034	Osimo	33737	18722	6698	35007	18993	7643	1270	3.76%	271	1.45%	945	14.11%
42	042035	Ostra	6837	3649	1551	6666	3556	1593	-171	-2.50%	-93	-2.55%	42	2.71%
42	042036	Ostra Vetere	3485	1868	835	3234	1638	920	-251	-7.20%	-230	-12.31%	85	10.18%
42	042037	Poggio San Marcello	772	395	195	671	361	161	-101	-13.08%	-34	-8.61%	-34	-17.44%
42	042038	Polverigi	4325	2553	653	4552	2616	820	227	5.25%	63	2.47%	167	25.57%
42	042040	Rosora	1952	1068	446	1950	1041	465	-2	-0.10%	-27	-2.53%	19	4.26%
42	042041	San Marcello	2093	1174	453	2008	1121	470	-85	-4.06%	-53	-4.51%	17	3.75%
42	042042	San Paolo di Jesi	916	474	234	916	485	239	0	0.00%	11	2.32%	5	2.14%
42	042043	Santa Maria Nuova	4263	2303	910	4097	2158	1001	-166	-3.89%	-145	-6.30%	91	10.00%
42	042044	Sassoferrato	7595	4065	1883	7070	3663	1934	-525	-6.91%	-402	-9.89%	51	2.71%
42	042045	Senigallia	45027	24904	10738	44620	23905	11590	-407	-0.90%	-999	-4.01%	852	7.93%
42	042046	Serra de' Conti	3741	2009	835	3737	1954	920	-4	-0.11%	-55	-2.74%	85	10.18%
42	042047	Serra San Quirico	3036	1645	776	2759	1416	769	-277	-9.12%	-229	-13.92%	-7	-0.90%
42	042048	Sirolo	3885	2215	865	4063	2216	986	178	4.58%	1	0.05%	121	13.99%
42	042049	Staffolo	2372	1240	565	2211	1209	540	-161	-6.79%	-31	-2.50%	-25	-4.42%
42	042050	Trecastelli	4371	2481	770	7569	4237	1585	3198	73.16%	1756	70.78%	815	105.84%
	Total Poppulation :		477828	262085	108873	471228	251267	117573	-6600	-1.38%	-10818	-4.13%	8700	7.99%

By linking the population with TTT to airports we get the colour code of the cities to reach the airport. For example the colour code is given to the cities respect with the TTT to reach the airport.

FALCONARA:

COD_Province	COD_Municipali	NAME_Municipality	Tot. Population 2011 (inh)	Population 26-65 2011 (inh)	Population >65 2011 (inh)	Tot. Population 2018 (inh)	Population 26-65 2018 (inh)	Population >65 2018 (inh)		Total difference 2018-2011 (inh)	Total variation 2018-2011 (%)	Difference pop. 26-65 2018-2011 (inh)	Variation pop. 26-65 2018-2011 (%)	Difference pop. >65 2018-2011 (inh)	Variation pop. >65 2018-2011 (%)
42	42001	Agugliano	4820	2752	773	4799	2686	913	19.02%	-21	-0.44%	-66	-2.40%	140	18.11%
42	42002	Ancona	102997	56186	23670	100924	53569	24712	24.49%	-2073	-2.01%	-2617	-4.66%	1042	4.40%
42	42003	Arcevia	5022	2551	1482	4496	2257	1429	31.78%	-526	-10.47%	-294	-11.52%	-53	-3.58%
42	42004	Barbara	1482	791	330	1335	691	349	26.14%	-147	-9.92%	-100	-12.64%	19	5.76%
42	42005	Belvedere Ostrense	2299	1199	558	2203	1168	546	24.78%	-96	-4.18%	-31	-2.59%	-12	-2.15%
42	42006	Camerano	7268	3990	1484	7218	3856	1613	22.35%	-50	-0.69%	-134	-3.36%	129	8.69%
42	42007	Camerata Picena	2369	1411	338	2552	1476	419	16.42%	183	7.72%	65	4.61%	81	23.96%
42	42008	Castelbellino	4858	2840	727	5009	2838	879	17.55%	151	3.11%	-2	-0.07%	152	20.91%
42	42009	Castelfidardo	18935	10472	3543	18601	10101	3792	20.39%	-334	-1.76%	-371	-3.54%	249	7.03%
42	42011	Castelleone di Suasa	1731	882	417	1605	843	405	25.23%	-126	-7.28%	-39	-4.42%	-12	-2.88%
42	42012	Castelplanio	3552	1951	755	3524	1883	799	22.67%	-28	-0.79%	-68	-3.49%	44	5.83%
42	42013	Cerreto d'Esi	4009	2214	678	3700	1998	766	20.70%	-309	-7.71%	-216	-9.76%	88	12.98%
42	42014	Chiaravalle	15036	8338	3343	14733	7758	3593	24.39%	-303	-2.02%	-580	-6.96%	250	7.48%
42	42015	Corinaldo	5152	2709	1297	4949	2545	1310	26.47%	-203	-3.94%	-164	-6.05%	13	1.00%
42	42016	Cupramontana	4929	2568	1205	4616	2411	1204	26.08%	-313	-6.35%	-157	-6.11%	-1	-0.08%
42	42017	Fabriano	31971	17454	7093	30809	16404	7403	24.03%	-1162	-3.63%	-1050	-6.02%	310	4.37%
42	42018	Falconara Marittima	27781	15056	6439	26063	13471	6982	26.79%	-1718	-6.18%	-1585	-10.53%	543	8.43%
42	42019	Filottrano	9745	5280	2032	9332	4990	2068	22.16%	-413	-4.24%	-290	-5.49%	36	1.77%
42	42020	Genga	1973	1082	489	1748	894	507	29.00%	-225	-11.40%	-188	-17.38%	18	3.68%
42	42021	Jesi	40635	21975	9611	40210	21188	9918	24.67%	-425	-1.05%	-787	-3.58%	307	3.19%
42	42022	Loreto	12543	6767	2741	12802	6825	2904	22.68%	259	2.06%	58	0.86%	163	5.95%
42	42023	Maiolati Spontini	6199	3472	1251	6187	3329	1458	23.57%	-12	-0.19%	-143	-4.12%	207	16.55%
42	42024	Mergo	1098	569	226	1008	552	226	22.42%	-90	-8.20%	-17	-2.99%	0	0.00%
42	42025	Monsano	3271	1920	547	3375	1878	671	19.88%	104	3.18%	-42	-2.19%	124	22.67%
42	42026	Montecarotto	2083	1082	544	1920	984	519	27.03%	-163	-7.83%	-98	-9.06%	-25	-4.60%
42	42027	Montemarciano	10236	5914	1893	9872	5493	2138	21.66%	-364	-3.56%	-421	-7.12%	245	12.94%
42	42029	Monte Roberto	3021	1742	496	3088	1681	587	19.01%	67	2.22%	-61	-3.50%	91	18.35%
42	42030	Monte San Vito	6666	3728	1240	6787	3774	1344	19.80%	121	1.82%	46	1.23%	104	8.39%
42	42031	Morro d'Alba	1970	1054	426	1873	972	446	23.81%	-97	-4.92%	-82	-7.78%	20	4.69%
42	42032	Numana	3875	2257	782	3763	2150	885	23.52%	-112	-2.89%	-107	-4.74%	103	13.17%
42	42033	Offagna	1895	1087	348	2025	1075	430	21.23%	130	6.86%	-12	-1.10%	82	23.56%
42	42034	Osimo	33737	18722	6401	35007	18993	7245	20.70%	1270	3.76%	271	1.45%	844	13.19%
42	42035	Ostra	6837	3649	1483	6666	3556	1527	22.91%	-171	-2.50%	-93	-2.55%	44	2.97%
42	42036	Ostra Vetere	3485	1868	799	3234	1638	877	27.12%	-251	-7.20%	-230	-12.31%	78	9.76%
42	42037	Poggio San Marcello	772	395	192	671	361	153	22.80%	-101	-13.08%	-34	-8.61%	-39	-20.31%
42	42038	Polverigi	4325	2553	621	4552	2616	773	16.98%	227	5.25%	63	2.47%	152	24.48%
42	42040	Rosora	1952	1068	429	1950	1041	447	22.92%	-2	-0.10%	-27	-2.53%	18	4.20%
42	42041	San Marcello	2093	1174	428	2008	1121	448	22.31%	-85	-4.06%	-53	-4.51%	20	4.67%
42	42042	San Paolo di Jesi	916	474	227	916	485	225	24.56%	0	0.00%	11	2.32%	-2	-0.88%
42	42043	Santa Maria Nuova	4263	2303	861	4097	2158	956	23.33%	-166	-3.89%	-145	-6.30%	95	11.03%
42	42044	Sassoferrato	7595	4065	1813	7070	3663	1866	26.39%	-525	-6.91%	-402	-9.89%	53	2.92%
42	42045	Senigallia	45027	24904	10223	44620	23905	11043	24.75%	-407	-0.90%	-999	-4.01%	820	8.02%
42	42046	Serra de' Conti	3741	2009	793	3737	1954	868	23.23%	-4	-0.11%	-55	-2.74%	75	9.46%
42	42047	Serra San Quirico	3036	1645	747	2759	1416	738	26.75%	-277	-9.12%	-229	-13.92%	-9	-1.20%
42	42048	Sirolo	3885	2215	827	4063	2216	932	22.94%	178	4.58%	1	0.05%	105	12.70%
42	42049	Staffolo	2372	1240	544	2211	1209	508	22.98%	-161	-6.79%	-31	-2.50%	-36	-6.62%
42	42050	Trecastelli	4371	2481	734	7569	4237	1484	19.61%	3198	73.16%	1756	70.78%	750	102.18%

The same process is repeted for every airport and the color code is given for the cites based on the TTT to reach the given airport from the city.

RIMINI:

COD_Province	COD_Municipali	NAME_Municipality	Tot. Population 2011 (inh)	Population 26-65 2011 (inh)	Population >65 2011 (inh)	Tot. Population 2018 (inh)	Population 26-65 2018 (inh)	Population >65 2018 (inh)		Total difference 2018-2011 (inh)	Total variation 2018-2011 (%)	Difference pop. 26-65 2018-2011 (inh)	Variation pop. 26-65 2018-2011 (%)	Difference pop. >65 2018-2011 (inh)	Variation pop. >65 2018-2011 (%)
42	42001	Agugliano	4820	2752	773	4799	2686	913	19.02%	-21	***-0.44%***	-66	***-2.40%***	140	***18.11%***
42	42002	Ancona	102997	56186	23670	100924	53569	24712	24.49%	-2073	***-2.01%***	-2617	***-4.66%***	1042	***4.40%***
42	42003	Arcevia	5022	2551	1482	4496	2257	1429	31.78%	-526	***-10.47%***	-294	***-11.52%***	-53	***-3.58%***
42	42004	Barbara	1482	791	330	1335	691	349	26.14%	-147	***-9.92%***	-100	***-12.64%***	19	***5.76%***
42	42005	Belvedere Ostrense	2299	1199	558	2203	1168	546	24.78%	-96	***-4.18%***	-31	***-2.59%***	-12	***-2.15%***
42	42006	Camerano	7268	3990	1484	7218	3856	1613	22.35%	-50	***-0.69%***	-134	***-3.36%***	129	***8.69%***
42	42007	Camerata Picena	2369	1411	338	2552	1476	419	16.42%	183	***7.72%***	65	***4.61%***	81	***23.96%***
42	42008	Castelbellino	4858	2840	727	5009	2838	879	17.55%	151	***3.11%***	-2	***-0.07%***	152	***20.91%***
42	42009	Castelfidardo	18935	10472	3543	18601	10101	3792	20.39%	-334	***-1.76%***	-371	***-3.54%***	249	***7.03%***
42	42011	Castelleone di Suasa	1731	882	417	1605	843	405	25.23%	-126	***-7.28%***	-39	***-4.42%***	-12	***-2.88%***
42	42012	Castelplanio	3552	1951	755	3524	1883	799	22.67%	-28	***-0.79%***	-68	***-3.49%***	44	***5.83%***
42	42013	Cerreto d'Esi	4009	2214	678	3700	1998	766	20.70%	-309	***-7.71%***	-216	***-9.76%***	88	***12.98%***
42	42014	Chiaravalle	15036	8338	3343	14733	7758	3593	24.39%	-303	***-2.02%***	-580	***-6.96%***	250	***7.48%***
42	42015	Corinaldo	5152	2709	1297	4949	2545	1310	26.47%	-203	***-3.94%***	-164	***-6.05%***	13	***1.00%***
42	42016	Cupramontana	4929	2568	1205	4616	2411	1204	26.08%	-313	***-6.35%***	-157	***-6.11%***	-1	***-0.08%***
42	42017	Fabriano	31971	17454	7093	30809	16404	7403	24.03%	-1162	***-3.63%***	-1050	***-6.02%***	310	***4.37%***
42	42018	Falconara Marittima	27781	15056	6439	26063	13471	6982	26.79%	-1718	***-6.18%***	-1585	***-10.53%***	543	***8.43%***
42	42019	Filottrano	9745	5280	2032	9332	4990	2068	22.16%	-413	***-4.24%***	-290	***-5.49%***	36	***1.77%***
42	42020	Genga	1973	1082	489	1748	894	507	29.00%	-225	***-11.40%***	-188	***-17.38%***	18	***3.68%***
42	42021	Jesi	40635	21975	9611	40210	21188	9918	24.67%	-425	***-1.05%***	-787	***-3.58%***	307	***3.19%***
42	42022	Loreto	12543	6767	2741	12802	6825	2904	22.68%	259	***2.06%***	58	***0.86%***	163	***5.95%***
42	42023	Maiolati Spontini	6199	3472	1251	6187	3329	1458	23.57%	-12	***-0.19%***	-143	***-4.12%***	207	***16.55%***
42	42024	Mergo	1098	569	226	1008	552	226	22.42%	-90	***-8.20%***	-17	***-2.99%***	0	***0.00%***
42	42025	Monsano	3271	1920	547	3375	1878	671	19.88%	104	***3.18%***	-42	***-2.19%***	124	***22.67%***
42	42026	Montecarotto	2083	1082	544	1920	984	519	27.03%	-163	***-7.83%***	-98	***-9.06%***	-25	***-4.60%***
42	42027	Montemarciano	10236	5914	1893	9872	5493	2138	21.66%	-364	***-3.56%***	-421	***-7.12%***	245	***12.94%***
42	42029	Monte Roberto	3021	1742	496	3088	1681	587	19.01%	67	***2.22%***	-61	***-3.50%***	91	***18.35%***
42	42030	Monte San Vito	6666	3728	1240	6787	3774	1344	19.80%	121	***1.82%***	46	***1.23%***	104	***8.39%***
42	42031	Morro d'Alba	1970	1054	426	1873	972	446	23.81%	-97	***-4.92%***	-82	***-7.78%***	20	***4.69%***
42	42032	Numana	3875	2257	782	3763	2150	885	23.52%	-112	***-2.89%***	-107	***-4.74%***	103	***13.17%***
42	42033	Offagna	1895	1087	348	2025	1075	430	21.23%	130	***6.86%***	-12	***-1.10%***	82	***23.56%***
42	42034	Osimo	33737	18722	6401	35007	18993	7245	20.70%	1270	***3.76%***	271	***1.45%***	844	***13.19%***
42	42035	Ostra	6837	3649	1483	6666	3556	1527	22.91%	-171	***-2.50%***	-93	***-2.55%***	44	***2.97%***
42	42036	Ostra Vetere	3485	1868	799	3234	1638	877	27.12%	-251	***-7.20%***	-230	***-12.31%***	78	***9.76%***
42	42037	Poggio San Marcello	772	395	192	671	361	153	22.80%	-101	***-13.08%***	-34	***-8.61%***	-39	***-20.31%***
42	42038	Polverigi	4325	2553	621	4552	2616	773	16.98%	227	***5.25%***	63	***2.47%***	152	***24.48%***
42	42040	Rosora	1952	1068	429	1950	1041	447	22.92%	-2	***-0.10%***	-27	***-2.53%***	18	***4.20%***
42	42041	San Marcello	2093	1174	428	2008	1121	448	22.31%	-85	***-4.06%***	-53	***-4.51%***	20	***4.67%***
42	42042	San Paolo di Jesi	916	474	227	916	485	225	24.56%	0	***0.00%***	11	***2.32%***	-2	***-0.88%***
42	42043	Santa Maria Nuova	4263	2303	861	4097	2158	956	23.33%	-166	***-3.89%***	-145	***-6.30%***	95	***11.03%***
42	42044	Sassoferrato	7595	4065	1813	7070	3663	1866	26.39%	-525	***-6.91%***	-402	***-9.89%***	53	***2.92%***
42	42045	Senigallia	45027	24904	10223	44620	23905	11043	24.75%	-407	***-0.90%***	-999	***-4.01%***	820	***8.02%***
42	42046	Serra de' Conti	3741	2009	793	3737	1954	868	23.23%	-4	***-0.11%***	-55	***-2.74%***	75	***9.46%***
42	42047	Serra San Quirico	3036	1645	747	2759	1416	738	26.75%	-277	***-9.12%***	-229	***-13.92%***	-9	***-1.20%***
42	42048	Sirolo	3885	2215	827	4063	2216	932	22.94%	178	***4.58%***	1	***0.05%***	105	***12.70%***
42	42049	Staffolo	2372	1240	544	2211	1209	508	22.98%	-161	***-6.79%***	-31	***-2.50%***	-36	***-6.62%***
42	42050	Trecastelli	4371	2481	734	7569	4237	1484	19.61%	3198	***73.16%***	1756	***70.78%***	750	***102.18%***

Pescara:

COD_Province	COD_Municipali	NAME_Municipality	Tot. Population	Population 26-65 2011 (inh)	Population >65 2011 (inh)	Tot. Population	Population 26-65 2018 (inh)	Population >65 2018 (inh)		Total difference 2018-2011	Total variation 2018-2011 (%)	Difference pop. 26-65	Variation pop. 26-65 2018-2011	Difference pop. >65 2018-2011	Variation pop. >65 2018-2011
42	42001	Agugliano	4820	2752	773	4799	2686	913	19.02%	-21	-0.44%	-66	-2.40%	140	18.11%
42	42002	Ancona	102997	56186	23670	100924	53569	24712	24.49%	-2073	-2.01%	-2617	-4.66%	1042	4.40%
42	42003	Arcevia	5022	2551	1482	4496	2257	1429	31.78%	-526	-10.47%	-294	-11.52%	-53	-3.58%
42	42004	Barbara	1482	791	330	1335	691	349	26.14%	-147	-9.92%	-100	-12.64%	19	5.76%
42	42005	Belvedere Ostrense	2299	1199	558	2203	1168	546	24.78%	-96	-4.18%	-31	-2.59%	-12	-2.15%
42	42006	Camerano	7268	3990	1484	7218	3856	1613	22.35%	-50	-0.69%	-134	-3.36%	129	8.69%
42	42007	Camerata Picena	2369	1411	338	2552	1476	419	16.42%	183	7.72%	65	4.61%	81	23.96%
42	42008	Castelbellino	4858	2840	727	5009	2838	879	17.55%	151	3.11%	-2	-0.07%	152	20.91%
42	42009	Castelfidardo	18935	10472	3543	18601	10101	3792	20.39%	-334	-1.76%	-371	-3.54%	249	7.03%
42	42011	Castelleone di Suasa	1731	882	417	1605	843	405	25.23%	-126	-7.28%	-39	-4.42%	-12	-2.88%
42	42012	Castelplanio	3552	1951	755	3524	1883	799	22.67%	-28	-0.79%	-68	-3.49%	44	5.83%
42	42013	Cerreto d'Esi	4009	2214	678	3700	1998	766	20.70%	-309	-7.71%	-216	-9.76%	88	12.98%
42	42014	Chiaravalle	15036	8338	3343	14733	7758	3593	24.39%	-303	-2.02%	-580	-6.96%	250	7.48%
42	42015	Corinaldo	5152	2709	1297	4949	2545	1310	26.47%	-203	-3.94%	-164	-6.05%	13	1.00%
42	42016	Cupramontana	4929	2568	1205	4616	2411	1204	26.08%	-313	-6.35%	-157	-6.11%	-1	-0.08%
42	42017	Fabriano	31971	17454	7093	30809	16404	7403	24.03%	-1162	-3.63%	-1050	-6.02%	310	4.37%
42	42018	Falconara Marittima	27781	15056	6439	26063	13471	6982	26.79%	-1718	-6.18%	-1585	-10.53%	543	8.43%
42	42019	Filottrano	9745	5280	2032	9332	4990	2068	22.16%	-413	-4.24%	-290	-5.49%	36	1.77%
42	42020	Genga	1973	1082	489	1748	894	507	29.00%	-225	-11.40%	-188	-17.38%	18	3.68%
42	42021	Jesi	40635	21975	9611	40210	21188	9918	24.67%	-425	-1.05%	-787	-3.58%	307	3.19%
42	42022	Loreto	12543	6767	2741	12802	6825	2904	22.68%	259	2.06%	58	0.86%	163	5.95%
42	42023	Maiolati Spontini	6199	3472	1251	6187	3329	1458	23.57%	-12	-0.19%	-143	-4.12%	207	16.55%
42	42024	Mergo	1098	569	226	1008	552	226	22.42%	-90	-8.20%	-17	-2.99%	0	0.00%
42	42025	Monsano	3271	1920	547	3375	1878	671	19.88%	104	3.18%	-42	-2.19%	124	22.67%
42	42026	Montecarotto	2083	1082	544	1920	984	519	27.03%	-163	-7.83%	-98	-9.06%	-25	-4.60%
42	42027	Montemarciano	10236	5914	1893	9872	5493	2138	21.66%	-364	-3.56%	-421	-7.12%	245	12.94%
42	42029	Monte Roberto	3021	1742	496	3088	1681	587	19.01%	67	2.22%	-61	-3.50%	91	18.35%
42	42030	Monte San Vito	6666	3728	1240	6787	3774	1344	19.80%	121	1.82%	46	1.23%	104	8.39%
42	42031	Morro d'Alba	1970	1054	426	1873	972	446	23.81%	-97	-4.92%	-82	-7.78%	20	4.69%
42	42032	Numana	3875	2257	782	3763	2150	885	23.52%	-112	-2.89%	-107	-4.74%	103	13.17%
42	42033	Offagna	1895	1087	348	2025	1075	430	21.23%	130	6.86%	-12	-1.10%	82	23.56%
42	42034	Osimo	33737	18722	6401	35007	18993	7245	20.70%	1270	3.76%	271	1.45%	844	13.19%
42	42035	Ostra	6837	3649	1483	6666	3556	1527	22.91%	-171	-2.50%	-93	-2.55%	44	2.97%
42	42036	Ostra Vetere	3485	1868	799	3234	1638	877	27.12%	-251	-7.20%	-230	-12.31%	78	9.76%
42	42037	Poggio San Marcello	772	395	192	671	361	153	22.80%	-101	-13.08%	-34	-8.61%	-39	-20.31%
42	42038	Polverigi	4325	2553	621	4552	2616	773	16.98%	227	5.25%	63	2.47%	152	24.48%
42	42040	Rosora	1952	1068	429	1950	1041	447	22.92%	-2	-0.10%	-27	-2.53%	18	4.20%
42	42041	San Marcello	2093	1174	428	2008	1121	448	22.31%	-85	-4.06%	-53	-4.51%	20	4.67%
42	42042	San Paolo di Jesi	916	474	227	916	485	225	24.56%	0	0.00%	11	2.32%	-2	-0.88%
42	42043	Santa Maria Nuova	4263	2303	861	4097	2158	956	23.33%	-166	-3.89%	-145	-6.30%	95	11.03%
42	42044	Sassoferrato	7595	4065	1813	7070	3663	1866	26.39%	-525	-6.91%	-402	-9.89%	53	2.92%
42	42045	Senigallia	45027	24904	10223	44620	23905	11043	24.75%	-407	-0.90%	-999	-4.01%	820	8.02%
42	42046	Serra de' Conti	3741	2009	793	3737	1954	868	23.23%	-4	-0.11%	-55	-2.74%	75	9.46%
42	42047	Serra San Quirico	3036	1645	747	2759	1416	738	26.75%	-277	-9.12%	-229	-13.92%	-9	-1.20%
42	42048	Sirolo	3885	2215	827	4063	2216	932	22.94%	178	4.58%	1	0.05%	105	12.70%
42	42049	Staffolo	2372	1240	544	2211	1209	508	22.98%	-161	-6.79%	-31	-2.50%	-36	-6.62%
42	42050	Trecastelli	4371	2481	734	7569	4237	1484	19.61%	3198	73.16%	1756	70.78%	750	102.18%

BOLOGNA:

COD_Province	COD_Municipali	NAME_Municipality	Tot. Population	Population 26-65 2011 (inh)	Population >65 2011 (inh)	Tot. Population	Population 26-65 2018 (inh)	Population >65 2018 (inh)		Total difference 2018-	Total Variation 2018-2011 (%)	Difference pop. 26-65	Variation pop. 26-65 2018-2011	Difference pop. >65 2018-	Variation pop. >65 2018-2011
42	42001	Agugliano	4820	2752	773	4799	2686	913	19.02%	-21	-0.44%	-66	-2.40%	140	18.11%
42	42002	Ancona	102997	56186	23670	100924	53569	24712	24.49%	-2073	-2.01%	-2617	-4.66%	1042	4.40%
42	42003	Arcevia	5022	2551	1482	4496	2257	1429	31.78%	-526	-10.47%	-294	-11.52%	-53	-3.58%
42	42004	Barbara	1482	791	330	1335	691	349	26.14%	-147	-9.92%	-100	-12.64%	19	5.76%
42	42005	Belvedere Ostrense	2299	1199	558	2203	1168	546	24.78%	-96	-4.18%	-31	-2.59%	-12	-2.15%
42	42006	Camerano	7268	3990	1484	7218	3856	1613	22.35%	-50	-0.69%	-134	-3.36%	129	8.69%
42	42007	Camerata Picena	2369	1411	338	2552	1476	419	16.42%	183	7.72%	65	4.61%	81	23.96%
42	42008	Castelbellino	4858	2840	727	5009	2838	879	17.55%	151	3.11%	-2	-0.07%	152	20.91%
42	42009	Castelfidardo	18935	10472	3543	18601	10101	3792	20.39%	-334	-1.76%	-371	-3.54%	249	7.03%
42	42011	Castelleone di Suasa	1731	882	417	1605	843	405	25.23%	-126	-7.28%	-39	-4.42%	-12	-2.88%
42	42012	Castelplanio	3552	1951	755	3524	1883	799	22.67%	-28	-0.79%	-68	-3.49%	44	5.83%
42	42013	Cerreto d'Esi	4009	2214	678	3700	1998	766	20.70%	-309	-7.71%	-216	-9.76%	88	12.98%
42	42014	Chiaravalle	15036	8338	3343	14733	7758	3593	24.39%	-303	-2.02%	-580	-6.96%	250	7.48%
42	42015	Corinaldo	5152	2709	1297	4949	2545	1310	26.47%	-203	-3.94%	-164	-6.05%	13	1.00%
42	42016	Cupramontana	4929	2568	1205	4616	2411	1204	26.08%	-313	-6.35%	-157	-6.11%	-1	-0.08%
42	42017	Fabriano	31971	17454	7093	30809	16404	7403	24.03%	-1162	-3.63%	-1050	-6.02%	310	4.37%
42	42018	Falconara Marittima	27781	15056	6439	26063	13471	6982	26.79%	-1718	-6.18%	-1585	-10.53%	543	8.43%
42	42019	Filottrano	9745	5280	2032	9332	4990	2068	22.16%	-413	-4.24%	-290	-5.49%	36	1.77%
42	42020	Genga	1973	1082	489	1748	894	507	29.00%	-225	-11.40%	-188	-17.38%	18	3.68%
42	42021	Jesi	40635	21975	9611	40210	21188	9918	24.67%	-425	-1.05%	-787	-3.58%	307	3.19%
42	42022	Loreto	12543	6767	2741	12802	6825	2904	22.68%	259	2.06%	58	0.86%	163	5.95%
42	42023	Maiolati Spontini	6199	3472	1251	6187	3329	1458	23.57%	-12	-0.19%	-143	-4.12%	207	16.55%
42	42024	Mergo	1098	569	226	1008	552	226	22.42%	-90	-8.20%	-17	-2.99%	0	0.00%
42	42025	Monsano	3271	1920	547	3375	1878	671	19.88%	104	3.18%	-42	-2.19%	124	22.67%
42	42026	Montecarotto	2083	1082	544	1920	984	519	27.03%	-163	-7.83%	-98	-9.06%	-25	-4.60%
42	42027	Montemarciano	10236	5914	1893	9872	5493	2138	21.66%	-364	-3.56%	-421	-7.12%	245	12.94%
42	42029	Monte Roberto	3021	1742	496	3088	1681	587	19.01%	67	2.22%	-61	-3.50%	91	18.35%
42	42030	Monte San Vito	6666	3728	1240	6787	3774	1344	19.80%	121	1.82%	46	1.23%	104	8.39%
42	42031	Morro d'Alba	1970	1054	426	1873	972	446	23.81%	-97	-4.92%	-82	-7.78%	20	4.69%
42	42032	Numana	3875	2257	782	3763	2150	885	23.52%	-112	-2.89%	-107	-4.74%	103	13.17%
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42	42034	Osimo	33737	18722	6401	35007	18993	7245	20.70%	1270	3.76%	271	1.45%	844	13.19%
42	42035	Ostra	6837	3649	1483	6666	3556	1527	22.91%	-171	-2.50%	-93	-2.55%	44	2.97%
42	42036	Ostra Vetere	3485	1868	799	3234	1638	877	27.12%	-251	-7.20%	-230	-12.31%	78	9.76%
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42	42040	Rosora	1952	1068	429	1950	1041	447	22.92%	-2	-0.10%	-27	-2.53%	18	4.20%
42	42041	San Marcello	2093	1174	428	2008	1121	448	22.31%	-85	-4.06%	-53	-4.51%	20	4.67%
42	42042	San Paolo di Jesi	916	474	227	916	485	225	24.56%	0	0.00%	11	2.32%	-2	-0.88%
42	42043	Santa Maria Nuova	4263	2303	861	4097	2158	956	23.33%	-166	-3.89%	-145	-6.30%	95	11.03%
42	42044	Sassoferrato	7595	4065	1813	7070	3663	1866	26.39%	-525	-6.91%	-402	-9.89%	53	2.92%
42	42045	Senigallia	45027	24904	10223	44620	23905	11043	24.75%	-407	-0.90%	-999	-4.01%	820	8.02%
42	42046	Serra de' Conti	3741	2009	793	3737	1954	868	23.23%	-4	-0.11%	-55	-2.74%	75	9.46%
42	42047	Serra San Quirico	3036	1645	747	2759	1416	738	26.75%	-277	-9.12%	-229	-13.92%	-9	-1.20%
42	42048	Sirolo	3885	2215	827	4063	2216	932	22.94%	178	4.58%	1	0.05%	105	12.70%
42	42049	Staffolo	2372	1240	544	2211	1209	508	22.98%	-161	-6.79%	-31	-2.50%	-36	-6.62%
42	42050	Trecastelli	4371	2481	734	7569	4237	1484	19.61%	3198	73.16%	1756	70.78%	750	102.18%

FIRENZE:

COD_Province	COD_Municipali	NAME_Municipality	Tot. Population	Population 26-65 2011 (inh)	Population >65 2011 (inh)	Tot. Population	Population 26-65 2018 (inh)	Population >65 2018 (inh)		Total difference 2018-2011	Total variation 2018-2011 (%)	Difference pop. 26-65	Variation pop. 26-65 2018-2011	Difference pop. >65 2018-	Variation pop. >65 2018-2011
42	42001	Agugliano	4820	2752	773	4799	2686	913	19.02%	-21	-0.44%	-66	-2.40%	140	18.11%
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42	42017	Fabriano	31971	17454	7093	30809	16404	7403	24.03%	-1162	-3.63%	-1050	-6.02%	310	4.37%
42	42018	Falconara Marittima	27781	15056	6439	26063	13471	6982	26.79%	-1718	-6.18%	-1585	-10.53%	543	8.43%
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42	42029	Monte Roberto	3021	1742	496	3088	1681	587	19.01%	67	2.22%	-61	-3.50%	91	18.35%
42	42030	Monte San Vito	6666	3728	1240	6787	3774	1344	19.80%	121	1.82%	46	1.23%	104	8.39%
42	42030	Monte San Vito	6666	3728	1240	6787	3774	1344	19.80%	121	1.82%	46	1.23%	104	8.39%
42	42031	Morro d'Alba	1970	1054	426	1873	972	446	23.81%	-97	-4.92%	-82	-7.78%	20	4.69%
42	42032	Numana	3875	2257	782	3763	2150	885	23.52%	-112	-2.89%	-107	-4.74%	103	13.17%
42	42033	Offagna	1895	1087	348	2025	1075	430	21.23%	130	6.86%	-12	-1.10%	82	23.56%
42	42034	Osimo	33737	18722	6401	35007	18993	7245	20.70%	1270	3.76%	271	1.45%	844	13.19%
42	42035	Ostra	6837	3649	1483	6666	3556	1527	22.91%	-171	-2.50%	-93	-2.55%	44	2.97%
42	42036	Ostra Vetere	3485	1868	799	3234	1638	877	27.12%	-251	-7.20%	-230	-12.31%	78	9.76%
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42	42040	Rosora	1952	1068	429	1950	1041	447	22.92%	-2	-0.10%	-27	-2.53%	18	4.20%
42	42041	San Marcello	2093	1174	428	2008	1121	448	22.31%	-85	-4.06%	-53	-4.51%	20	4.67%
42	42042	San Paolo di Jesi	916	474	227	916	485	225	24.56%	0	0.00%	11	2.32%	-2	-0.88%
42	42043	Santa Maria Nuova	4263	2303	861	4097	2158	956	23.33%	-166	-3.89%	-145	-6.30%	95	11.03%
42	42044	Sassoferrato	7595	4065	1813	7070	3663	1866	26.39%	-525	-6.91%	-402	-9.89%	53	2.92%
42	42045	Senigallia	45027	24904	10223	44620	23905	11043	24.75%	-407	-0.90%	-999	-4.01%	820	8.02%
42	42046	Serra de' Conti	3741	2009	793	3737	1954	868	23.23%	-4	-0.11%	-55	-2.74%	75	9.46%
42	42047	Serra San Quirico	3036	1645	747	2759	1416	738	26.75%	-277	-9.12%	-229	-13.92%	-9	-1.20%
42	42048	Sirolo	3885	2215	827	4063	2216	932	22.94%	178	4.58%	1	0.05%	105	12.70%
42	42049	Staffolo	2372	1240	544	2211	1209	508	22.98%	-161	-6.79%	-31	-2.50%	-36	-6.62%
42	42050	Trecastelli	4371	2481	734	7569	4237	1484	19.61%	3198	73.16%	1756	70.78%	750	102.18%

From the table we get the total population of the entire region is 471228
Considering only cities where "old" population (>65 years old) is <25% (87,3% of ancona's total population)

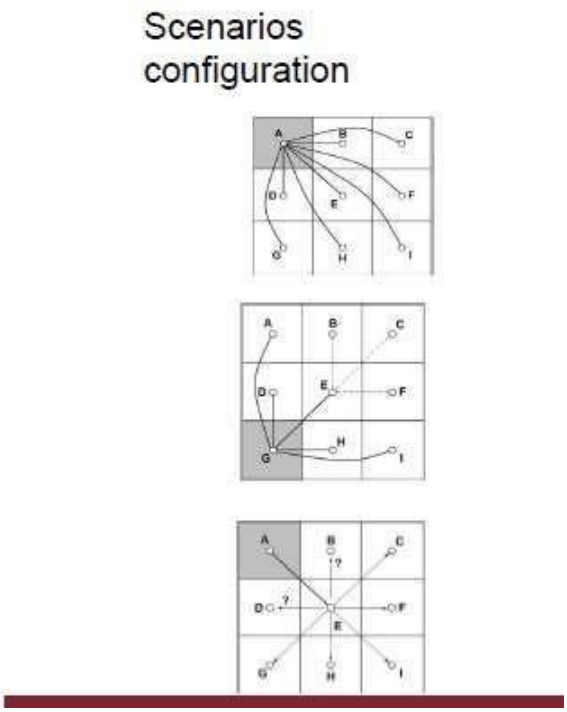
		From which airport ?				
		Falconara	*Rimini*	*Pescara*	*Bologna*	*Firenze*
Less than x minutes	*t <30 min*	3,70,452	0	0	0	0
		78.4%	0.0%	0.0%	0.0%	0.0%
	31min<t<60 min	42,009	96,875	0	0	0
		8.9%	20.5%	0.0%	0.0%	0.0%
	61min<t<90 min	0	2,84,777	0	0	0
		0.0%	60.3%	0.0%	0.0%	0.0%
	91min<t<120 min	0	30,809	2,31,073	67,945	0
		0.0%	6.5%	48.9%	14.4%	0.0%
	t >121 min	0	0	1,81,388	3,45,516	4,12,461
		0.0%	0.0%	38.4%	73.2%	87.3%

By neglecting the population above 65 years old we get the entire population of the region which uses the airtransport. With that we have the TTT for each airport from the given cities so that we can get the number of people accessing the airports.

- A major part of the region is closed from Falconara and could use it as regional/national airport.
- The population is globally closer from Rimini than Pescara
- Considering that Pescara is also far for 40% of the population, it seems reasonable to prefer to go to Bologna.
- The same part of population is far from Firenze or Bologna. They maybe should go to the most connected airport of these two.

Exercise No. 3

[Rehabilitating Falconara Airport]



TO DO:

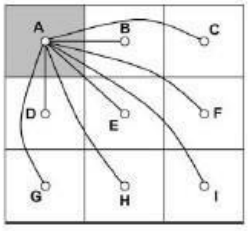
1. Estimate potential demand according to EX1 and EX 2 outcomes.
2. Estimate supply.
3. Build scenarios according to the three configurations.
4. Assess most favorable scenario.

Solution :-

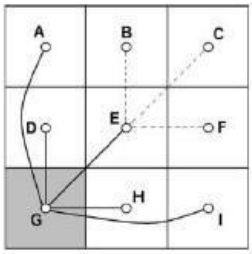
We will try to find out the solution in which ultimately, we will comment on the best configuration.

The three configurations are:-

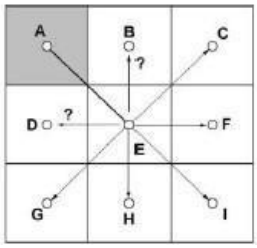
Point to Point



Point to Point Adapted



Hub&Spoke



While we start with the process, we will note down some of the assumptions that have been made according to the data that has been made available in the explanation of the question.

Assumptions :-

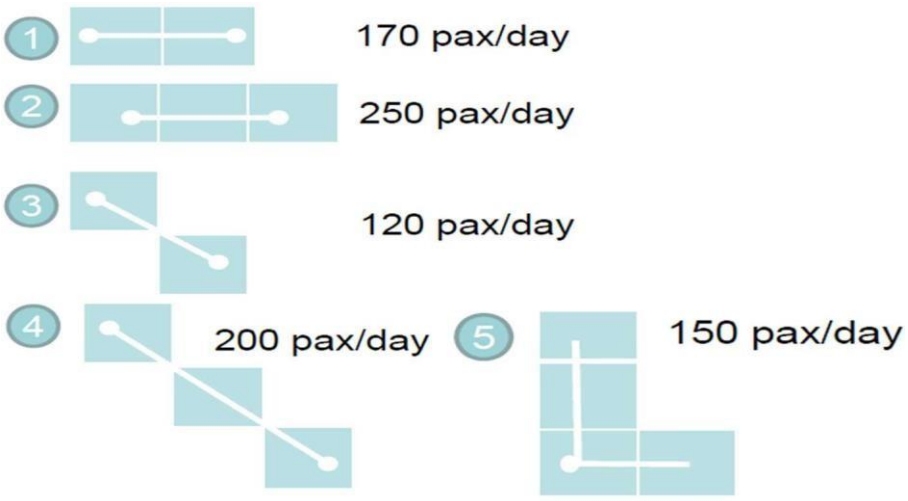
Population

We assumed that eligible demand for Falconara 150000 pax/year for this project as a start. We also assumed that our demand will increase by 20% until 2029.

Supply

60 % load factor, as a start and the load factor will reach 75% in 2029 40-seat aircraft max. (free to have smaller supply)

5 Demand Patterns



9 Airports

A	B	C
D	E	F
G	H	I

Scenarios

We have 3 different scenarios in order to determine total demand and also, 3 different location types such as corner, central of edge and centre.

Demand Pattern

Constraints:

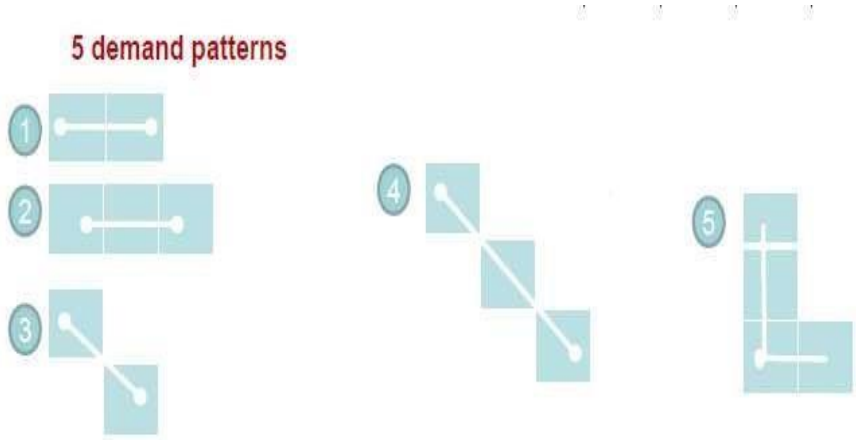
- ❖ Point-to-point adapted, demand patterns 4 and 5 reduced by 25%
- ❖ Hub & Spoke, demand pattern 1 reduced by 50%

Now, as we have stated our assumptions that we will take into consideration while we make our calculations, we will now start with the calculation part of the exercise.

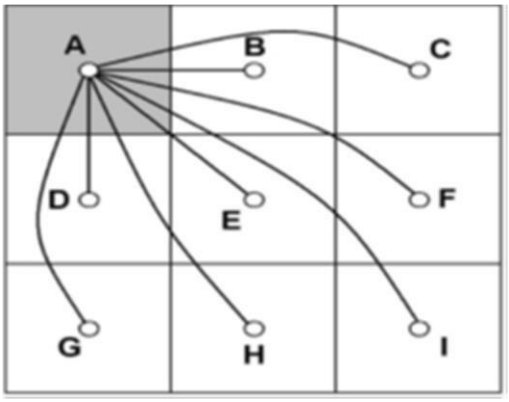
For this there will be Two sets of calculation:-

1. 2019, we will study all the three configurations on today's scenario with 60% load factor as stated above.
2. 2029, we will study all the three configurations on 2029 with 75% load factor (increment which may happen during the years).
   So let us start with all the calculations related to **2019**.

POINT TO POINT – 2019



Point to Point scenario :-



We are given the number of passengers that will travel during the whole year. We can calculate the number of passengers with the help of that.

	2019
Annual Pax	150000
Daily Pax	400

So as we have found out that the number of passengers travelling can be estimated to daily passenger 400, we will now find out the Projected demand pattern values for a day as shown in the sheet below :-

Pattern	Demand	Percentage	Project D.P values
1	170	19%	76
2	250	28%	112
3	120	13%	54
4	200	22%	90
5	150	17%	67

We now know the projected demand pattern values. Let us depict the demand pattern as shown in the figure below with airport at corner, central of edge and centre configurations.

CORNER			**CENTRAL OF EDGE**			**CENTRE**		
	76	112	76		76	54	76	54
76	54	67	54	76	54	76		76
112	67	90	67	112	67	54	76	54

We will now calculate with all possible locations. Then after adding up all we will get the total passenger/ day added up from all the locations.

	Corner	Centre of edge	centre
Demand	656	584	521
Location	4	4	1
Total Demand	2625	2337	521
Total Pax/day	**5483**		

Now as we have assumed that the maximum number of each aircraft is offering is 40 and the load factor will be considered as 60%, we will calculate the service configuration as shown below :-

Assume that number of seats for each aircraft	40
Assume load factor	60%

SERVICE CONFIGURATION						
Demand Pattern	Pax day per pattern	Fleet supply	Seat generated	Required seats	Load Factor	Payload
1	76	4	160	127	60%	96
2	112	5	200	187		120
3	54	3	120	90		72
4	90	4	160	150		96
5	67	3	120	112		72

Now it is time that we calculate the frequency of the services that we are providing. We will calculate the routes generated and the flights per day that we offer.

FREQUENCY MATRIX							
Pattern	1	2	3	4	5	Routes Generated	Flights per day
Demand(Pax/day)	76	112	54	90	67		
Fleet Supply	4	5	3	4	3		
Corner (4 locations)	2	2	1	1	2	8	31
Central of Edge(4 locations)	3	1	2	0	2	8	29
Centre (1 locations)	4	0	4	0	0	8	28
TOTAL	9	3	7	1	4	**24**	**88**

Now we will calculate the number of services that can be generated

SERVICE MATRIX						
Pattern	1	2	3	4	5	Services Generated
Demand	76	112	54	90	67	
Fleet Supply	4	5	3	4	3	
Corner (4 locations)	8	8	4	4	8	32
Central of Edge (4 locations)	12	4	8	0	8	32
Centre (1 location)	4	0	4	0	0	8
TOTAL	24	12	16	4	16	**72**

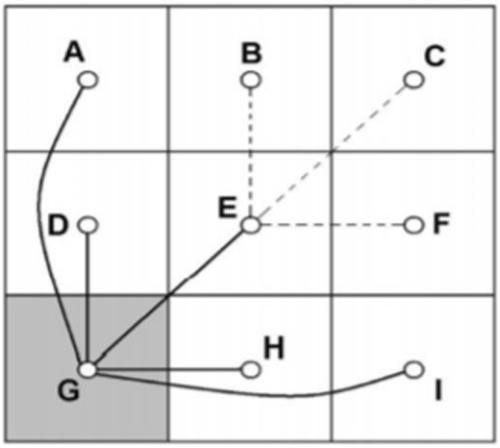
At last we will calculate the number of average passengers per flight that can be made to travel with this Point to point configuration

SUPPLY MATRIX							
Pattern	1	2	3	4	5	TOTAL	Average passengers per flight
Demand	76	112	54	90	67		
Fleet Supply	4	5	3	4	3		
Corner (4 locations)	32	40	12	16	24	124	
Central of Edge (4 locations)	48	20	24	0	24	116	
Centre (1 location)	16	0	12	0	0	28	
TOTAL AIRCRAFTS	96	60	48	16	48	**268**	**21**

Hence we find that we are able to transport 21 passengers per flight with the help of point to point configuration.

POINT TO POINT ADAPTED – 2019

Point to point adapted scenario:-



So as we have found out that the number of passengers travelling can be estimated to daily passenger 400, we will now find out the Projected demand pattern values for a day as shown in the sheet below. Remember that the scenario of the demand pattern has been changed from the last one and the changes are Demand for Pattern 4 and 5 reduces 25% each:-

Pattern	Demand	Percentage	Project D.P values
1	170	19%	76
2	250	28%	112
3	120	13%	55
4	150	19%	78
5	113	14%	56

We now know the projected demand pattern values. Let us depict the demand pattern as shown in the figure below with airport at corner, central of edge and centre configurations.

CORNER			CENTRAL OF EDGE			CENTRE		
	76	112	76		76	55	76	55
76	55	56	55	76	55	76		76
112	56	78	56	112	56	55	76	55

We will now calculate with all possible locations. Then after adding up all we will get the total passenger/ day added up from all the locations.

Demand	621	562	524
Location	4	4	1
Total Demand	2484	2248	524
Total Pax/day	**5256**		

Now as we have assumed that the maximum number of each aircraft is offering is 40 and the load factor will be considered as 60%, we will calculate the service configuration as shown below:-

Assume that number of seats for each aircraft	40
Assume load factor	60%

SERVICE CONFIGURATION						
Demand Pattern	Pax day per pattern	Fleet supply	Seat generated	Required seats	Load Factor	Payload
1	76	4	160	127	60%	96
2	112	5	200	187		120
3	55	3	120	92		72
4	78	4	160	130		96
5	56	3	120	93		72

Now it is time that we calculate the frequency of the services that we are providing. We will calculate the routes generated and the flights per day that we offer.

FREQUENCY MATRIX							
Pattern	1	2	3	4	5	Routes Generated	Flights per day
Demand(Pax/day)	76	112	55	78	56		
Fleet Supply	4	5	3	4	3		
Corner (4 locations)	2	2	1	0	0	5	21
Central of Edge(4 locations)	3	1	2	0	0	6	23
Centre (1 locations)	4	0	4	0	0	8	28
TOTAL	9	3	7	0	0	**19**	**72**

Now we will calculate the number of services that can be generated

SERVICE MATRIX						
Pattern	1	2	3	4	5	Services Generated
Demand	76	112	55	78	56	
Fleet Supply	4	5	3	4	3	
Corner (4 locations)	8	8	4	0	0	20
Central of Edge (4 locations)	12	4	8	0	0	24
Centre (1 location)	4	0	4	0	0	8
TOTAL	24	12	16	0	0	**52**

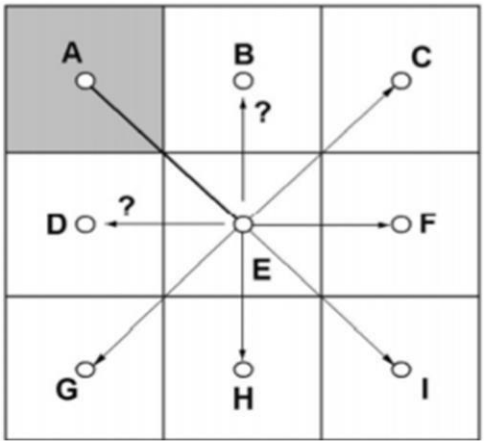
At last we will calculate the number of average passengers per flight that can be made to travel with this Point to point adapted configuration

SUPPLY MATRIX							
Pattern	1	2	3	4	5	TOTAL	Average passengers per flight
Demand	76	112	55	78	56		
Fleet Supply	4	5	3	4	3		
Corner (4 locations)	32	40	12	0	0	84	
Central of Edge (4 locations)	48	20	24	0	0	92	
Centre (1 location)	16	0	12	0	0	28	
TOTAL AIRCRAFTS	96	60	48	0	0	**204**	**26**

Hence we find that we are able to transport 26 passengers per flight with the help of point to point adapted configuration.

HUB AND SPOKE - 2019

Hub and spoke scenario :-



So as we have found out that the number of passengers travelling can be estimated to daily passenger 400, we will now find out the Projected demand pattern values for a day as shown in the sheet below. Remember that the scenario of the demand pattern has been changed from the last one and the changes are that the Demand of pattern 1 has reduced by 50% :-

Pattern	Demand	Percentage	Project D.P values
1	85	11%	44
2	250	28%	112
3	120	13%	55
4	200	22%	92
5	150	17%	69

We now know the projected demand pattern values. Let us depict the demand pattern as shown in the figure below with airport at corner, central of edge and centre configurations.

CORNER			CENTRAL OF EDGE			CENTRE		
	44	112	44		44	55	44	55
44	55	69	55	44	55	44		44
112	69	92	69	112	69	55	44	55

We will now calculate with all possible locations. Then after adding up all we will get the total passenger/ day added up from all the locations.

Demand	597	492	396
Location	4	4	1
Total Demand	2388	1968	396
Total Pax/day	**4752**		

Now as we have assumed that the maximum number of each aircraft is offering is 40 and the load factor will be considered as 60%, we will calculate the service configuration as shown below:-

Assume that number of seats for each aircraft	40
Assume load factor	60%
SERVICE CONFIGURATION	

Demand Pattern	Pax day per pattern	Fleet supply	Seat generated	Required seats	Load Factor	Payload
1	44	2	80	73	60%	48
2	112	5	200	187		120
3	55	3	120	92		72
4	92	4	160	153		96
5	69	3	120	115		72

Now it is time that we calculate the frequency of the services that we are providing. We will calculate the routes generated and the flights per day that we offer.

FREQUENCY MATRIX							
Pattern	1	2	3	4	5	Routes Generated	Flights per day
Demand(Pax/day)	44	112	55	92	69		
Fleet Supply	2	5	3	4	3		
Corner (4 locations)	0	0	1	0	0	1	3
Central of Edge(4 locations)	1	0	0	0	0	1	2
Centre (1 locations)	4	0	4	0	0	8	20
TOTAL	5	0	5	0	0	**10**	**25**

Now we will calculate the number of services that can be generated

SERVICE MATRIX						
Pattern	1	2	3	4	5	Services Generated
Demand	44	112	55	92	69	
Fleet Supply	2	5	3	4	3	
Corner (4 locations)	0	0	4	0	0	4
Central of Edge (4 locations)	4	0	0	0	0	4
Centre (1 location)	4	0	4	0	0	8
TOTAL	8	0	8	0	0	**16**

At last we will calculate the number of average passengers per flight that can be made to travel with this Hub and spoke configuration

SUPPLY MATRIX							
Pattern	1	2	3	4	5	TOTAL	Average passengers per flight
Demand	44	112	55	92	69		
Fleet Supply	2	5	3	4	3		
Corner (4 locations)	0	0	12	0	0	12	
Central of Edge (4 locations)	8	0	0	0	0	8	
Centre (1 location)	8	0	12	0	0	20	
TOTAL AIRCRAFTS	16	0	24	0	0	**40**	**119**

Hence, we find that we are getting a number as 119 passengers per flight in the configuration of hub and spoke in our calculation. But we already know that the maximum number of seats available per flight is 40. So this case can be considered as unrealistic as it does not serve to our real considerations.

Now as we have done our calculations regarding the current year i.e. 2019 with 60% load factor, it is time for us to do some future broadcasting. We will now analyse the future i.e. 2029 with load factor increased up to 75%.

So, let us start with all the calculations related to **2029**.

POINT TO POINT -2029

We consider that a moderate development happened in the number of passengers that use the service during the next 10 years. We consider that there is a increment of 20% of the total passengers.

	2029
Annual Pax	180000
Daily Pax	480

So as we have found out that the number of passengers travelling can be estimated to daily passenger 480, we will now find out the Projected demand pattern values for a day as shown in the sheet below :-

Pattern	Demand	Percentage	Project D.P values
1	204	19%	92
2	300	28%	135
3	144	13%	65
4	240	22%	108
5	180	17%	81

We now know the projected demand pattern values. Let us depict the demand pattern as shown in the figure below with airport at corner, central of edge and centre configurations.

CORNER			**CENTRAL OF EDGE**			**CENTRE**		
	92	135	92		92	65	92	65
92	65	81	65	92	65	92		92

	135	81	108	81	135	81	65	92	65

We will now calculate with all possible locations. Then after adding up all we will get the total passenger/ day added up from all the locations.

Demand	787	701	626
Location	4	4	1
Total Demand	3150	2804	626
Total Pax/day	**6580**		

Now as we have assumed that the maximum number of each aircraft is offering is 40 and the load factor will be considered as 75%, we will calculate the service configuration as shown below:-

Assume that number of seats for each aircraft	40
Assume Load Factor	75%

SERVICE CONFIGURATION

Demand Pattern	Pax day per pattern	Fleet supply	Seat generated	Required seats	Load Factor	Pay load
1	92	4	160	122	75%	120
2	135	5	200	180		150
3	65	3	120	86		90
4	108	4	160	144		120
5	81	3	120	108		90

Now it is time that we calculate the frequency of the services that we are providing. We will calculate the routes generated and the flights per day that we offer.

FREQUENCY MATRIX							
Pattern	1	2	3	4	5	Routes Generated	Flights per day
Demand(Pax/day)	92	135	65	108	81		
Fleet Supply	4	5	3	4	3		
Corner (4 locations)	2	2	1	1	2	8	31
Central of Edge (4 locations)	3	1	2	0	2	8	29
Centre (1 location)	4	0	4	0	0	8	28
TOTAL	9	3	7	1	4	**24**	**88**

Now we will calculate the number of services that can be generated

SERVICE MATRIX						
Pattern	1	2	3	4	5	Services Generated
Demand(Pax/day)	92	135	65	108	81	
Fleet Supply	4	5	3	4	3	
Corner (4 locations)	8	8	4	4	8	32
Central of Edge (4 locations)	12	4	8	0	8	32
Centre (1 location)	4	0	4	0	0	8
TOTAL	24	12	16	4	16	**72**

At last we will calculate the number of average passengers per flight that can be made to travel with this Point to point configuration

SUPPLY MATRIX							
Pattern	1	2	3	4	5	TOTAL	Average passengers per flight
Demand(Pax/day)	92	135	65	108	81		
Fleet Supply	4	5	3	4	3		
Corner (4 locations)	32	40	12	16	24	124	
Central of Edge (4 locations)	48	20	24	0	24	116	
Centre (1 location)	16	0	12	0	0	28	
TOTAL AIRCRAFTS	96	60	48	16	48	**268**	**25**

Hence we find that we are able to transport 25 passengers per flight with the help of point to point configuration in 2029.

POINT TO POINT ADAPTED -2029

So, as we have found out that the number of passengers travelling can be estimated to daily passenger 480, we will now find out the Projected demand pattern values for a day as shown in the sheet below. Remember that the scenario of the demand pattern has been changed from the last one and the changes are Demand for Pattern 4 and 5 reduces 25% each:-

Pattern	Demand	Percentage	Project D.P values
1	204	19%	91
2	300	28%	139
3	144	13%	66
4	180	18%	86
5	135	14%	67

We now know the projected demand pattern values. Let us depict the demand pattern as shown in the figure below with airport at corner, central of edge and centre configurations

CORNER			**CENTRAL OF EDGE**			**CENTRE**		
	91	139	91		91	66	91	66
91	66	67	66	91	66	91		91
139	67	86	67	139	67	66	91	66

We will now calculate with all possible locations. Then after adding up all we will get the total passenger/ day added up from all the locations.

Demand	747	679	629
Location	4	4	1
Total Demand	2989	2716	629
Total Pax/day	**6334**		

Now as we have assumed that the maximum number of each aircraft is offering is 40 and the load factor will be considered as 75%, we will calculate the service configuration as shown below:-

Assume that number of seats for each aircraft	40
Assume Load Factor	75%

SERVICE CONFIGURATION

Demand Pattern	Pax day per pattern	Fleet supply	Seat generated	Required seats	Load Factor	Pay load
1	91	4	160	122	75%	120
2	139	5	200	185		150
3	66	3	120	88		90
4	86	3	120	115		90
5	67	3	120	90		90

Now it is time that we calculate the frequency of the services that we are providing. We will calculate the routes generated and the flights per day that we offer.

FREQUENCY MATRIX

Pattern	1	2	3	4	5	Routes Generated	Flights per day
Demand(Pax/day)	91	139	66	86	67		
Fleet Supply	4	5	3	3	3		

Corner (4 locations)	2	2	1	0	0	5	21
Central of Edge (4 locations)	3	1	2	0	0	6	23
Centre (1 location)	4	0	4	0	0	8	28
TOTAL	9	3	7	0	0	**19**	**72**

Now we will calculate the number of services that can be generated

SERVICE MATRIX						
Pattern	1	2	3	4	5	Services Generated
Demand(Pax/day)	91	139	66	86	67	
Fleet Supply	4	5	3	3	3	
Corner (4 locations)	8	8	4	0	0	20
Central of Edge (4 locations)	12	4	8	0	0	24
Centre (1 location)	4	0	4	0	0	8
TOTAL	24	12	16	0	0	**52**

At last we will calculate the number of average passengers per flight that can be made to travel with this Point to point adapted configuration

SUPPLY MATRIX							
Pattern	1	2	3	4	5	TOTAL	Average passengers per flight
Demand(Pax/day)	91	139	66	86	67		
Fleet Supply	4	5	3	3	3		
Corner (4 locations)	32	40	12	0	0	84	
Central of Edge (4 locations)	48	20	24	0	0	92	
Centre (1 location)	16	0	12	0	0	28	
TOTAL AIRCRAFTS	96	60	48	0	0	**204**	**32**

Hence we find that we are able to transport 32 passengers per flight with the help of point to point configuration in 2029.

HUB AND SPOKE -2029

So as we have found out that the number of passengers travelling can be estimated to daily passenger 480, we will now find out the Projected demand pattern values for a day as shown in the sheet below. Remember that the scenario of the demand pattern has been changed from the last one and the changes are Demand for Pattern 1 is reduced by 50%:-

Pattern	Demand	Percentage	Project D.P values
1	102	11%	51
2	300	28%	139
3	144	13%	66
4	240	22%	111
5	180	17%	83

We now know the projected demand pattern values. Let us depict the demand pattern as shown in the figure below with airport at corner, central of edge and centre configurations

CORNER			**CENTRAL OF EDGE**			**CENTRE**		
	51	139	51		51	66	51	66
51	66	83	66	51	66	51		51
139	83	111	83	139	83	66	51	66

We will now calculate with all possible locations. Then after adding up all we will get the total passenger/ day added up from all the locations.

Demand	722	589	467
Location	4	4	1
Total Demand	2889	2356	467
Total Pax/day	**5712**		

Now as we have assumed that the maximum number of each aircraft is offering is 40 and the load factor will be considered as 75%, we will calculate the service configuration as shown below:-

Assume that number of seats for each aircraft	40
Assume Load Factor	75%

SERVICE CONFIGURATION

Demand Pattern	Pax day per pattern	Fleet supply	Seat generated	Required seats	Load Factor	Pay load
1	51	2	80	68	75%	60
2	139	5	200	185		150
3	66	3	120	88		90
4	111	4	160	148		120
5	83	3	120	111		90

Now it is time that we calculate the frequency of the services that we are providing. We will calculate the routes generated and the flights per day that we offer.

FREQUENCY MATRIX							
Pattern	1	2	3	4	5	Routes Generated	Flights per day
Demand(Pax/day)	51	139	66	111	83		
Fleet Supply	2	5	3	4	3		
Corner (4 locations)	0	0	1	0	0	1	3
Central of Edge (4 locations)	1	0	0	0	0	1	2
Centre (1 location)	4	0	4	0	0	8	20
TOTAL	5	0	5	0	0	**10**	**25**

Now we will calculate the number of services that can be generated

SERVICE MATRIX						
Pattern	1	2	3	4	5	Services Generated
Demand(Pax/day)	51	139	66	111	83	
Fleet Supply	2	5	3	4	3	
Corner (4 locations)	0	0	4	0	0	4
Central of Edge (4 locations)	4	0	0	0	0	4
Centre (1 location)	4	0	4	0	0	8
TOTAL	8	0	8	0	0	**16**

At last we will calculate the number of average passengers per flight that can be made to travel with this Hub and spoke configuration

SUPPLY MATRIX							
Pattern	1	2	3	4	5	TOTAL	Average passengers per flight
Demand(Pax/day)	51	139	66	111	83		
Fleet Supply	2	5	3	4	3		
Corner (4 locations)	0	0	12	0	0	12	
Central of Edge (4 locations)	8	0	0	0	0	8	
Centre (1 location)	8	0	12	0	0	20	
TOTAL AIRCRAFTS	16	0	24	0	0	**40**	143

Hence we find that we are getting a number as 143 passengers per flight in the configuration of hub and spoke in our calculation. But we already know that the maximum number of seats available per flight is 40. So this case can be considered as unrealistic as it does not serve to our real considerations.

Compilations of all the results for coming to a conclusion.

2019			
	Point to Point	**Point to Point adapted**	**Hub and Spoke**
Number of direct (one way) services	72	52	16
Range of frequencies (flights/day)	88	72	25
Trip passengers	5483	5256	4752
Average passengers per flight	21	26	119
Corner's airports passengers originating			
Total Passengers	2625	2484	2388
Routes	8	5	1
Departures per day	124	84	12
Edge's airports passengers originating			
Total Passengers	2337	2248	1968
Routes	8	6	1
Departures per day	116	92	8
Centre airports passengers originating			
Total Passengers	521	524	396
Routes	8	8	8
Departures per day	28	28	20

2029			
	Point to Point	**Point to Point adapted**	**Hub and Spoke**
Number of direct (one way) services	72	52	16
Range of frequencies (flights/day)	88	72	25
Trip passengers	6580	6334	5712
Average passengers per flight	25	32	143
Corner's airports passengers originating			
Total Passengers	3150	2989	2889
Routes	8	5	1
Departures per day	124	84	12
Edge's airports passengers originating			
Total Passengers	2804	2716	2356
Routes	8	6	1
Departures per day	116	92	8
Centre airports passengers originating			
Total Passengers	626	629	467
Routes	8	8	8
Departures per day	28	28	20

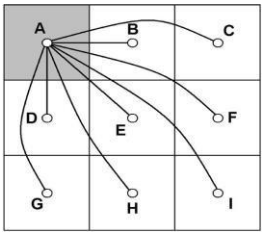
From the above configuration, what we have tried to conclude is that Falconara airport can be in a **Point to Point adapted** location. The reason being that in this case we can fairly manage to have manageable number of flights per day and the number of passengers per flight and the total passengers travelling also is a acceptable value. When we are integrating it with the analysis of the scenario of the next 10 years, then also we find the Point to Point adapted case well acceptable.

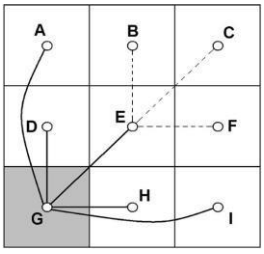
Exercise 4

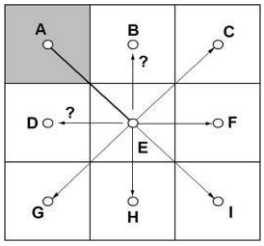
[SERVICE CONFIGURATION FOR CAPACITY ASSESSMENT]

Rehabilitating Falconara Airport

SCENARIOS







WE HAVE…,

1. Estimate capacity for the traffic scenarios
2. Estimate capacity for the configurations in ex. 3 (add 3 more services/h due to civil aviation traffic at peak hour)
3. Estimate number of gates, T= 45 min
4. Redesign Scenario E with the assumption of buffer times to be specifically calculated; tmax= 30 sec

5. Create an operational scenario with the hourly saturation capacity in peak time: 8h00 to 9h00 (50% of the daily traffic), and off-peak from 9h00 to 21h00, 360 days

6. Qualitatively compare with the supply estimated for the Falconara Airport.

Peak time: 8h00 to 9h00)		
Percentage of daily traffic	**50%**	
Time Peroid During Peak Hours	**2**	**Hours**
Traffic During time period of 1 Hour	**27**	
Total Traffic During Peak Hours	**54**	
Total Gates Used Per Hour	27	
Average Seperation Time	**133,3333**	**Seconds**

Off-peak from 9h00 to 21h00		
Persentage of Daily Traffic	**50%**	
Time Peroid During Peak Hours	**12**	**Hours**
Traffic During the Off-Peak Hours	**54**	
Traffic During the peroid of Hour	**4,5**	
Total Gates Used per hour	4,5	

Average Seperation Time	800	Seconds

Solution

Scenario A

Given that,

Aircraft Type	Mix %	Approach Speed(kts)	ROT(sec)
Large (2)	15%	120	55
Small (3)	70%	100	50
Light (4)	15%	85	45

Seperation Metrix

S_{ij}	2	3	4
2	3	4	4
3	3	3	3
4	3	3	2,5

To find,

$$T_{ij} = max\left(\frac{n + s_{ij}}{v_j} - \frac{n}{v_i}, o_i\right)$$

$$T_{ij} = \max\left(\frac{sij}{v_j}, o_i\right)$$

Where,

Tij = min. time separation

between i and j at runway

n = length of final approach (8

n.mi.)

sij = separation in air

between i and j

vi, vj = approach

speed of i, j

Oi, Oj = runway occupancy time of i, j

T_{ij}	Min. time separation between i and j at runway (Seconds)		
	2	3	4
2	90	192	268
3	90	108	178
4	90	108	106

tij = average time interval between successive

movements of a pair of aircraft of types i and j

(i followed by j) such that no ATC separation

requirements are violated

tij = Tij + b

with

b = safety buffer 10 seconds between each

aircraft for safety

Tij = min. time separation between i and j

at runway

Safety buffer	b	10	Sceconds

tij	Average Seperation Matrix (Seconds)		

	2	3	4
2	100	202	278
3	100	118	188
4	100	118	116

Probability matrix P_{ij}

p_{ij}	1	2	3
1	0.02	0.11	0.02
2	0.11	0.49	0.11
3	0.02	0.11	0.02

Average separation between couple of aircraft

$$E(t) = \sum_i \sum_j t_{ij} p_{ij}$$

E (t) = 146.4025 sec

Saturation Capacity

3600 / E (t) = n – aircraft

Saturation Capacity = 25

aircraft

Scenario B

Given that,

Type	Mix %	Approach Speed (kts)	Runway Time Occupancy ROT (sec)
Heavy	10	140	60
Large	20	120	55
Small	70	100	50

S_{ij}	1	2	3
1	4	5	6
2	3	3	4
3	3	3	3

To find,

$$T_{ij} = max\left(\frac{n + s_{ij}}{v_j} - \frac{n}{v_i}, o_i\right)$$

$$T_{ij} = \max\left(\frac{sij}{v_j}, o_i\right)$$

Where,

T_{ij} = min. time separation between i and j

at runway

n = length of final approach (8n.mi.)

s_{ij} = separation in air

between i and j

v_i, v_j = approach speed of

i, j

O_i, O_j = runway occupancy time of i, j

T_{ij}	1	2	3
1	103	185	299
2	78	90	192
3	78	90	108

t_{ij} = average time interval between successive movements of a pair of aircraft

of types i and j (i followed by j) such that no ATC separation requirements are

violated $t_{ij} = T_{ij} + b$

with

b = safety buffer 10 seconds between each aircraft

for safety

T_{ij} = min. time separation between i and j at runway

t_{ij}	1	2	3
1	113	195	309
2	88	100	202
3	88	100	118

Probability matrix P_{ij}

p_{ij}	1	2	3
1	0.01	0.02	0.07
2	0.02	0.04	0.14
3	0.07	0.14	0.49

Average separation between couple of aircraft

$$E(t) = \sum_i \sum_j t_{ij} p_{ij}$$

E (t) = 138.68 sec

Saturation Capacity

3600 / E (t) =

n – aircraft Saturation

Capacity = 26 aircraft

Scenario C

Given that,

Type	**Mix %**	**Approach Speed (kts)**	**Runway Time Occupancy ROT (sec)**
Heavy	1	140	60
Large	30	120	55
Small	50	100	50
Light	19	85	45

Sij	1	2	3	4
1	4	5	6	8
2	3	3	4	4
3	3	3	3	3
4	3	3	3	2.5

To find,

$$T_{ij} = max\left(\frac{n + s_{ij}}{v_j} - \frac{n}{v_i}, o_i\right)$$

$$T_{ij} = \max\left(\frac{sij}{v_j}, o_i\right)$$

Where,

T_{ij} = min. time separation between i and j

at runway

n = length of final approach (8n.mi.)

s_{ij} = separation in air

between i and j

v_i, v_j = approach speed of

i,j

O_i, O_j = runway occupancy time of i, j

$\mathbf{T_{ij}}$	1	2	3	4
1	103	185	216	472
2	78	90	144	269
3	78	90	108	178
4	78	90	108	106

t_{ij} = average time interval between successive movements of a pair of

aircraft of types i and j (i followed by j) such that no ATC separation

requirements are

violated
$t_{ij} = T_{ij} + b$
with
b = safety buffer 10 seconds between each aircraft

for safety

T_{ij} = min. time separation between i and j at runway

$\mathbf{t_{ij}}$	1	2	3	4
1	113	195	226	482
2	88	100	154	279
3	88	100	118	188
4	88	100	118	116

Probability matrix P_{ij}

p_{ij}	1	2	3	4
1	0.00	0.00	0.01	0.00
2	0.00	0.09	0.15	0.06
3	0.01	0.15	0.25	0.10
4	0.00	0.06	0.10	0.04

Average separation between couple of aircraft

$$E(t) = \sum_i \sum_j t_{ij} p_{ij}$$

E (t) = 134.9739 sec

Saturation Capacity

3600 / E (t) =n – aircraft

Saturation Capacity = 27 aircraft

From the saturation capacity we found out that the scenario C have the greatest number of aircraft movements per hour.

We need to find the number of gates required to satisfy all the

demand. Number of gates required for the airport according to the

arrival rate of flights. G= A(T+S)

A= Flight arrival rate (from previous

exercises)

T= gate occupancy time(45 mins)

S= gate separation requirement (15 mins)

	2019			**2029**		
	Point to point	**Point to point Adapted**	**Hub & Spoke**	**Point to point**	**Point to point Adapted**	**Hub & Spoke**

Flights/day	88	72	25	88	72	25
Flight/hour	4	3	2	4	3	2
Gates	**7**	**6**	**5**	**7**	**6**	**5**

Redesign Scenario E with the assumption of buffer times to be specifically calculated; tmax= 30 sec

Redesign Scenario E

Given that,

Type	Mix %	Approach Speed (kts)	Runway Time Occupancy ROT (sec)
Super	15	145	65
Heavy	25	140	60
B 757	10	135	55
Large	15	120	45
Small	15	110	45
Light	20	100	45

S_{ij}	1	2	3	4	5	6
1	6	6	8	8	10	10
2	4	4	5	5	6	6
3	4	4	4	4	4	5
4	3	3	3	3	3	4
5	3	3	3	3	3	3
6	2.5	2.5	2.5	2.5	2.5	3

To find,

$$T_{ij} = max\left(\frac{n + s_{ij}}{v_j} - \frac{n}{v_i}, o_i\right)$$

$$T_{ij} = \max\left(\frac{sij}{v_j}, o_i\right)$$

Where,

T_{ij} = min. time separation between i and j

at runway

n = length of final approach (8 n.mi.)

s_{ij} = separation in air

between i and j v_i, v_j =

approach speed of i, j

O_i, O_j = runway occupancy time of i, j

T_{ij}	1	2	3	4	5	6
1	149	162	229	282	391	450
2	100	103	141	185	253	299
3	100	103	107	147	180	255
4	75	78	80	90	120	192
5	75	78	80	90	99	135
6	63	65	67	75	82	108

t_{ij} = average time interval between successive movements of a pair of

aircraft of types i and j (i followed by j) such that no ATC separation

requirements are violated

$t_{ij} = T_{ij} +$

with

b = safety buffer 30 seconds between each aircraft

for safety

T_{ij} = min. time separation between i and j at runway

tij	1	2	3	4	5	6
1	179	192	259	312	421	480
2	130	133	171	215	283	329
3	130	133	137	177	210	285
4	105	108	110	120	150	222
5	105	108	110	120	129	165
6	93	95	97	105	112	138

Probability matrix P_{ij}

Pij	1	2	3	4	5	6
1	0.02	0.04	0.02	0.02	0.02	0.03
2	0.04	0.06	0.03	0.04	0.04	0.05
3	0.02	0.03	0.01	0.02	0.02	0.02
4	0.02	0.04	0.02	0.02	0.02	0.03
5	0.02	0.04	0.02	0.02	0.02	0.03
6	0.03	0.05	0.02	0.03	0.03	0.04

Average separation between couple of aircraft

$$E(t) = \sum_i \sum_j t_{ij} p_{ij}$$

E (t) = 177.665 sec

Saturation Capacity

3600/ E (t) = n – aircraft

Saturation Capacity = 20 aircraft

It shows buffer time increases then the saturation capacity will be decreases that's buffer time inversely proportional to saturation capacity.

REFERENCE :

- https://www.tuttitalia.it/marche/provincia-di-ancona/
- https://maps.google.com/landing/transit/index.html
- **Hirst, M., Air Transport Systems, Springer, Cambridge 1996**

Examples in sections 1.2 - 1.4