ECO-III-1042

Energy Conservation and Commercialization (ECO-III)

Benchmarking Energy consumption in buildings: Preliminary Data Analysis

Final Report

Saket Sarraf, Shilpi Anand Saboo, Shravani Gupta
ps Collective

September 2011

Submitted to
Aalok Deshmukh
Chief of Party (Team Leader), USAID ECO-III Project
International Resources Group

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ENERGY IS LIFE
BEE
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Chief of Party (Team Leader), USAID ECO-III Project
International Resources Group
AADI Building (Lower Ground Floor), 2, Balbir Saxena Marg, Hauz Khas
New Delhi-110016, India
***E-mail**: adeshmukh@irgssa.com*

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Inspired by the Commercial Building Energy Consumption Survey (CBECS) and driven by a desire to address a complete absence of energy consumption data for Indian commercial building sector, ECO-III team partnered with BEE and a host of organizations to collect standardized and reliable data on different types of commercial buildings in India. The effort resulted in collection of building level energy use data from more than 860 buildings (office, hotel, hospital, retail) and a detailed analysis that has, for the first time, provided benchmarking indices (e.g. kWh/m^2/year, kWh/m2/hour, kWh/bed/year, kWh/room/year, etc.). These indices can be used by policy makers, building designers, ESCOs, energy auditors, energy analysts and researchers to better understand current status and the future of energy usage in different sectors.

This report documents the step-by-step process used in preliminary data analysis for offices, hotels and hospitals. The key variables included total electricity purchased from the utility, total electricity generated on site through DG/GG sets, climatic zone, built up area, air conditioning load, and information about the intensity of use - number of employees and hours of operation in office, number of beds in hospitals and number of rooms in the hotel.

Section 1 details the first round of data cleaning including typos, creation of auxiliary variables, and application of logical filters for consistency. It provides high level summary for data based on building types and ownership, conditioning levels, data source, and location characteristics like place, climatic zone, heating and cooling degree days, etc.

Sections 2 through 4 focus on individual building types namely – office, hospital and hotels. For each building type, the section discusses the data cleaning process, identifies potential outliers based on univariate and multivariate analysis and finally summarizes and classifies data in different groups by climatic zone, subtypes, etc. Section 5 presents the comparative analysis across building types.

This document is the first step in building a perspective of commercial buildings and their operations. For example, the office section presents the distribution of office space per employee, coverage per tonnage of air conditioning, distribution of office sizes, hours of operation, etc. Further, it provides the energy use intensity based on multiple metrics such as per unit area, per employee, per hour of operation etc. Similar statistics are presented for hotels and hospitals where the focus is on energy intensities based on number of rooms and number of beds in addition to other standard descriptive measures. However, the primary purpose of this report is to share the data analysis steps that preceded and informed the benchmarking process.

Contents

1.Data management

1.1. Data definition

epi:	Energy Performance Intensity (Kilowatt Hours per sq mt.)
kwh:	Total annual energy consumption in Kilowatt Hours
bua:	Built-up area
car.con:	Conditioned carpet area
floors:	Number of floors
hrs.day:	Hours of operation in a day
days.week:	Working days in a week
hrs:	Hours of operation in a year
emp:	Total number of employees
bua.emp:	BUA per employee Number of employees per sq mt
pac2:	Percent of conditioned space (conditioned carpet area/ built-up area)
pac_i:	"Unconditioned" (if, pac<40%), "Conditioned" (if pac>=40%)
av.temp:	average annual temperature of the city
cdd18.3:	Cooling degree days with base = 18.3 °C
cdh23.3:	Cooling degree hours with base = 23.3 °C
cdh26.7:	Cooling degree hours with base = 26.7 °C
cdd:	Cooling degree days (old dataset)
city:	City where building is located
climate:	Climatic zone of the city
sub.meter:	Whether sub meters are available (y/n)
type:	Building use type
sub category:	Sub groups of building use type
tot.tr:	Total AC load
con.load:	Connected Load (KW)
con.dem:	Contract Demand (KVA)
dg:	Installed capacity: DG/ GG Sets (kVA)
elec.pur:	Annual Electricity Consumption, purchased from Utilities (kWh)
elec.dg:	Annual Electricity Consumption, through Diesel Generating (DG) / Gas Generating (GG) Set(s) (kWh)
elec.pur.cost:	Annual Cost of Electricity, purchased from Utilities (Rs.)
elec.dg.cost:	Annual Cost of Electricity generated through DG/GG Sets (Rs.)

elec.cost:	Total Annual Electricity Cost, Utilities + DG/GG Sets (Rs.)
bua.bed:	Space per bed in Hospital
emp.bed	Employee per bed in Hospital

1.2. Primary cleaning

Variable	Old content	New content
city	“Dehra Dun”	“Dehradun”
own	“public” or “Public Sector” "private"	"Public" "Private"
sub.meter	"No"	“no”
type	"office"	"Office"
Sub category	"4&5 star Category" " " "Multi specialty" or "multi specialty"	"4.5.star" "" "Multi Specialty"
Climate	" Temperate" " Cold" "composite" "warm & Humid"	"Temperate" "Cold" "Composite" "Warm & Humid"

1.3. Data Transformations

1.3.1. Auxiliary variables

epi = kwh / bua

pac2 = car.con / bua

pac_i = if pac2>=0.4, "Conditioned" else "Unconditioned"

empden = emp / bua Employees per sq mt

bua.emp = bua / emp Space per employee

hrs = hrs.day × days.week × 52.1428571428571

shifts = 1 (0-8 hrs per day), 2 (8-16 hrs per day), 2 (16-24 hrs per day)

ar.tr = car.con / tot.tr (Conditioned carpet area / Total AC load)

1.3.2. Regrouping Building types

Original	# observations	Modified	# observations
"College"	2	Education	31
"Education "	10		
"Educational Institute"	5		
"Institution"	13		
"Library"	1		
"Hospital"	153	Hospital	153
"Hotel"	184	Hotel	184
"Auditorium"	1	Misc	28
"Data Center"	1		
"Factory"	3		
"Guest House"	2		
"Hostel"	6		
"Museum"	1		
"Office + workshop"	1		
"Sports/recreation"	4		
"Theatre"	8		
"Workshop"	1		
"Office"	305	Office	321

"Office Govt"	16		
"Commercial"	1	Retail	43
"Retail"	19		
"Retail Outlet"	3		
"Shopping Mall"	20		

1.4. Primary filters: Logical filters

Variable(s)	Filter	Observations	Action	Data count
				760
kwh, elec.pur, elec.dg	elec.pur+elec.dg =kwh	BID 34 (diff 65%) BID 68 (diff 12%)	elec.pur, elec.dg, kwh set to "NA"	760
ppatients	<=1	BID 31, ppatients = 30	Data edited to 0.3	760
prooms	<=1			760
bua, car.con	bua>car.con	BIDs 473, 549, 567	bua and car.con set to "NA"	760
days.week	<=7			760
hrs.day	<=24			760

1.5. Initial Data summary

No. of observations = 760

id	Var. name	obs.	mean	median	s.d.	min.	max.
2	epi	740	263.11	209.33	260.39	1.61	2926.01
9	elec.pur	576	2997447.76	1416016	5056349.97	6000	48600000
10	elec.dg	487	312196.88	42500	1493373.34	0	27893589
11	kwh	749	3123690.35	1383352	5267648.25	2256	48924000
12	con.load	445	1250.8	590	2061.96	5	18000
13	con.dem	403	1285.28	704	1697.06	16	14400
14	dg	345	1569.04	760	2144.55	0	15060
15	elec.pur.cost	553	17520155.17	7200000	29949031.54	52632	291600000
16	elec.dg.cost	488	3885541.17	4e+05	21083828.52	0	295488000
17	elec.cost	601	20806687.04	7500000	49725957.8	0	933768286
18	bua	751	17866.2	6000	55104.97	70	1101654
19	car.con	489	11379.16	4000	23195.63	0	373787
20	floors	231	6.9	5	6.02	1	47
21	pac2	487	0.67	0.75	0.28	0	1
23	empden	454	0.11	0.05	0.22	0	2.5
24	av.temp	619	26.27	26	1.46	23.7	29.3
28	hrs	564	6497.85	8760	2774.7	2008	8760
29	hrs.day	619	18.28	24	6.85	8	24
30	days.week	565	6.41	7	0.84	4	7
32	emp	457	772.79	265	1456.33	8	13000
33	occup	219	1037.06	400	1744.71	16	13771
34	nrooms	146	117.92	81	98.2	24	520
35	visitors	70	39521.94	11591.5	91434.3	3500	576748
36	prooms	32	0.7	0.7	0.14	0.27	0.95
37	nbeds	130	244.29	130	309.9	15	1803
38	opd.day	72	174.21	97.5	225.13	25	1500
39	ppatients	7	0.68	0.7	0.2	0.3	0.9
40	tot.tr	469	574.41	280	771.58	0	5722
41	ar.tr	364	23.32	16.02	39.64	0	621.48
42	bua.emp	454	48.67	18.42	361.41	0.4	7374

1.5.1. Building Types and Ownership

Type	**# observations**			**Sub-types**	**# observations**
	Total	Private	Public		
Education	31	16	15		
Hospital	153	142	11	Multi Specialty	129
Hotel	184	183	1	4.5.star	48
Misc	28	24	4		
Office	321	232	89	BPO	91
Retail	43	43	0		
Total	760	640	120		

Table 1-1:

1.5.2. Climatic Zones and Conditioning status

No. of observations	Conditioned	Unconditioned	NA	Total
Cold	13	2	30	45
Composite	132	45	91	268
Hot & Dry	33	11	47	91
Temperate	63	8	32	103
Warm & Humid	163	17	73	253
Total	404	83	273	760

1.5.3. Source

	Source	Freq
1	BEE	50
2	CEPT	3
3	CII	11
4	CPWD	5
5	DLF	8
6	DSCL	89
7	ECO-III Hospital Data	3
8	ICF	6
9	ICMQ BPO	91
10	ICMQ Hospital	101
11	ICMQ Hotel	109
12	IIM-A	15
13	ISHRAE	67
14	ITC	3
15	Jaypee	3
16	LBNL	112
17	Lilavati	1
18	Mckinsey	1
19	MEDA	27
20	Paharpur	1
21	PEDA	11
22	RBI	29
23	Reliance	6
24	SBI	1
25	TERI	7
	Total	**760**

Table 1-2:

1.5.4. Cities, CDD and Climate

S.No	City	cdh23.3	cdh26.7	cdd18.3	climate	av.temp	#obsv
1	Agra				Composite		3
2	Ahmedabad	44605	24353	3435	Hot & Dry	27.7	50
3	Ajmer				Hot & Dry		3
4	Amritsar	45907	23158	3442	Composite		1
5	Aurangabad	30961	15431	2707	Hot & Dry	25.7	2
6	Baddi				Composite		4
7	Bangalore	15090	4979	2121	Temperate	24.1	84
8	Bhavnagar				Hot & Dry		1
9	Bhilwara				Hot & Dry		1
10	Bhopal	32499	16984	2707	Composite	25.6	1
11	Bhubaneswar	37257	16438	3343	Warm & Humid	27.5	4
12	Chandigarh				Composite		20
13	Chennai	44343	20813	3802	Warm & Humid	28.7	48
14	Cochin				Warm & Humid		2
15	Darjeeling				Cold		2
16	Dehradun	17372	6002	1634	Composite		7
17	Delhi	37217	21187	2762	Composite	25.2	58
18	Faridabad	42516	25343	3011	Composite	25.8	4
19	Gangtok				Cold		1
20	Gulbarga				Composite		1
21	Gurgaon	42516	25343	3011	Composite	25.8	19
22	Guwahati	23669	8529	2344	Cold	24.6	1
23	Hissar	42773	26406	3064	Composite	26	1
24	Hospet				Warm & Humid		1
25	Hyderabad	35148	17066	3095	Composite	26.8	32
26	Jaipur	39235	22276	2918	Composite	25.9	59
27	Jalandhar				Composite		2
28	Jalgaon				Hot & Dry		1
29	Jammu				Cold		1
30	Jamnagar				Warm & Humid		1
31	Jodhpur	47234	28226	3366	Hot & Dry	27.4	4
32	Kanpur				Composite		1
33	Kochi				Warm & Humid		1
34	Kolkata	35592	15909	3056	Warm & Humid	26.7	29
35	Kota				Hot & Dry		9
36	Kullu				Cold		1
37	Lucknow	35728	19267	2756	Composite	25.4	4
38	Ludhiana				Composite		8
39	Manali				Cold		5
40	Mandi				Cold		1

S.No	city	cdh23.3	cdh26.7	cdd18.3	climate	av.temp	#obsv
41	Manipal				Warm & Humid		1
42	Mewat				Warm & Humid		1
43	Mohali	42516	25343	3011	Composite	25.8	6
44	Mount Abu				Cold		1
45	Mumbai	37791	15252	3360	Warm & Humid	27.5	105
46	Mussoorie				Cold		1
47	Mysore	15090	4979	2121	Temperate	24.1	19
48	Nagpur	40125	22073	3221	Composite	27.1	11
49	Nanital				Cold		2
50	Nashik				Hot & Dry		1
51	Navi Mumbai	37791	15252	3360	Warm & Humid	27.5	2
52	New Delhi	42516	25343	3011	Composite	25.8	10
53	Noida	42516	25343	3011	Composite	25.8	4
54	Ooty				Cold		9
55	Panchkula				Composite		1
56	Patiala	30399	16307	2356	Composite	23.7	3
57	Patna	35984	18438	2843	Composite	25.8	1
58	Pithoragarh				Cold		1
59	Pune	22919	10154	2298	Warm & Humid	24.6	34
60	Raichak	35592	15909	3056	Warm & Humid	26.7	3
61	Rajkot	41435	21422	3410	Composite	27.7	3
62	Shillong	150	0	120	Warm & Humid		6
63	Shimla				Cold		12
64	Sikar				Composite		1
65	Srinagar				Cold		7
66	Sunderbans				Warm & Humid		2
67	Surat	39941	17891	3418	Hot & Dry	27.7	4
68	Thiruvanantapuram	34177	11796	3374	Warm & Humid	27.6	2
69	Tiruchchirappalli	48987	25169	3984	Composite	29.3	1
70	Udaipur				Hot & Dry		5
71	Vadodara				Hot & Dry		9
72	Vapi				Hot & Dry		1
73	Vishakapatnam	37806	14113	3379	Warm & Humid	27.6	11
74	Warangal				Composite		1
75	Yamunanagar				Composite		1

Note:

The above table has 760 observations (and is based on pre-primary filtered data)
Cities in database 75
City with CDD information: 35
The following assignments are made for cities with no CDD info:
Delhi <-- Safdarjung, Navi Mumbai <-- Mumbai

2. Sector Specific Data: Office

2.1. Initial Summary

No. of observations = 321

	Var. name	obs.	mean	median	s.d.	min.	max.
3	epi	312	231.93	174.34	214.45	7.83	1800
10	elec.pur	258	3621633.33	1395275	6708188.96	6000	48600000
11	elec.dg	210	504233.48	60129.5	2092712.67	0	27893589
12	kwh	313	3733395.95	1421000	6768283.85	6000	48924000
13	con.load	212	1375.01	619.45	2105.16	19	14875
14	con.dem	188	1535.66	850	1912.05	16	11900
15	dg	222	1795.89	700	2512.67	0	15060
16	elec.pur.cost	251	19885844.32	7971056	35750713.23	52632	291600000
17	elec.dg.cost	217	7203037.63	516455	31067488	0	295488000
18	elec.cost	258	26940385.54	8376110	69542573.81	52632	933768286
19	bua	320	24206.92	7466	80105.25	70	1101654
20	car.con	276	12594.29	4000	28339.91	15	373787
21	floors	127	7.7	6	6.91	1	47
22	pac2	276	0.69	0.75	0.26	0	1
23	pac_i	276	1.145	1	0.353	1	2
24	empden	220	0.16	0.09	0.29	0	2.5
29	hrs	257	4396.14	3128.57	2494.34	2008	8760
30	hrs.day	279	13.56	10	6.21	8	24
31	days.week	257	5.79	6	0.85	4.81	7
33	emp	221	1272.64	531	1872.29	8	13000
34	occup	189	1111.4	450	1835.26	16	13771
41	tot.tr	266	659.43	300	891.63	2	5722
42	ar.tr	234	20.66	14.82	26.22	1.5	246.65
43	bua.emp	220	49.43	11.22	496.33	0.4	7374

Table 2-1:

2.2. Space per employee

Original Density / Box plot

bua.emp (space per employee)

Observation: bua.emp = 7,374 sq mts, BIDs: 56 321

Action: emp set to "NA"

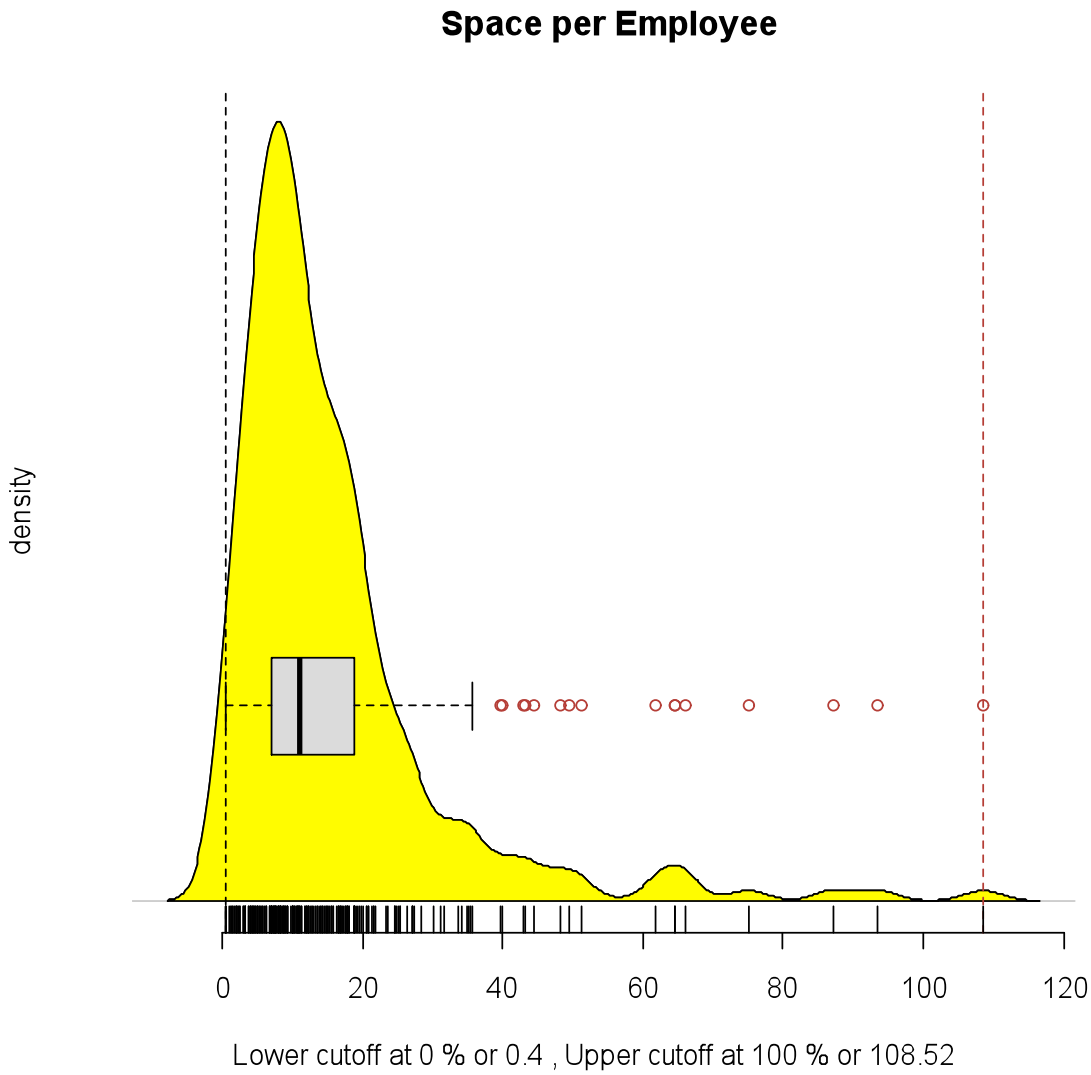


Figure 2-1

Original

```
    Min.  1st Qu.   Median     Mean  3rd Qu.     Max.     NA's
   0.400    7.069   11.220   49.430   18.970 7374.000  101.000
Modified
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NA's
  0.400   7.048  11.030  15.990  18.970 108.500 102.000
```

2.3. Employee per sq mt

Original Density / Box plot

321

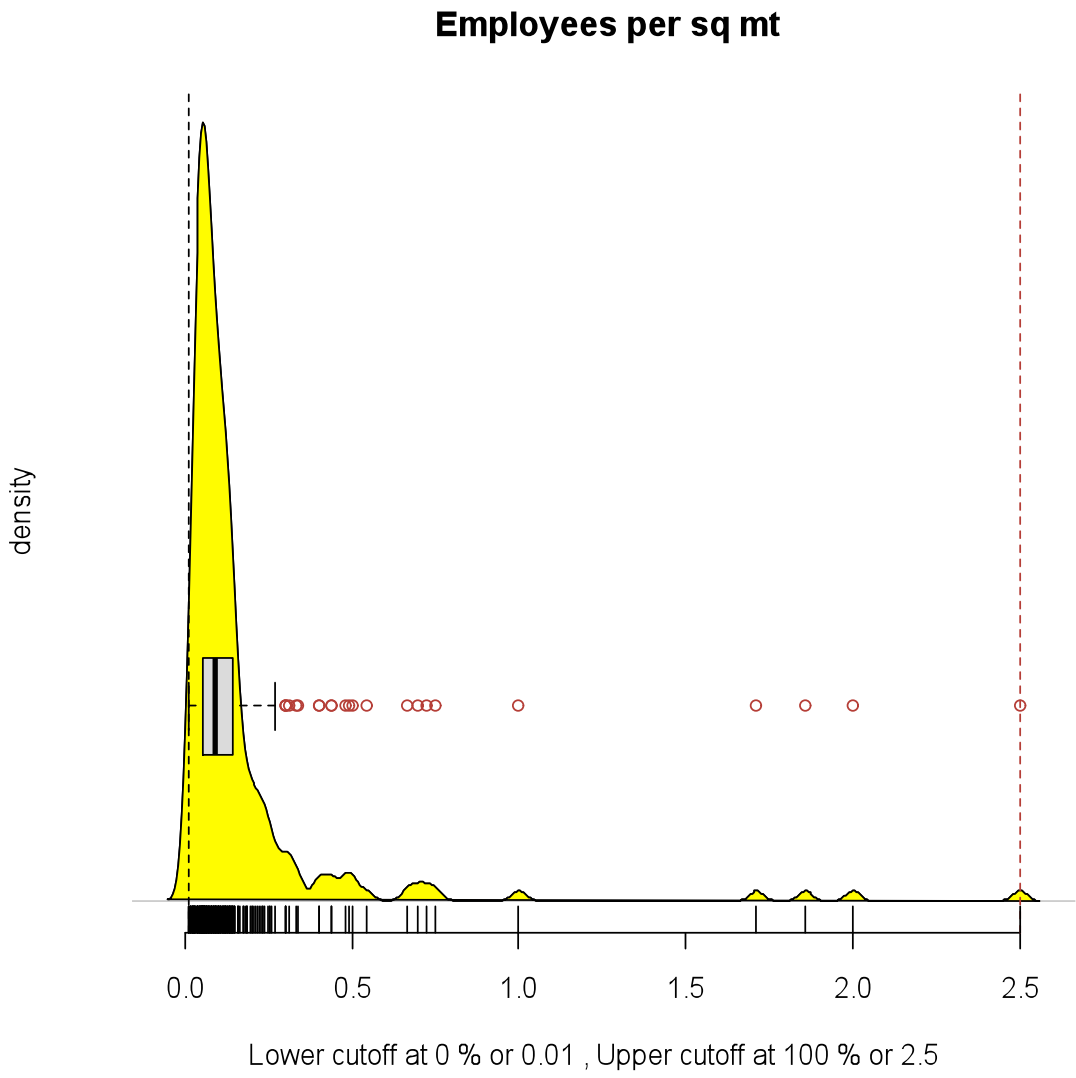


Figure 2-2

```
Original
     Min.   1st Qu.    Median      Mean   3rd Qu.      Max.      NA's
9.215e-03 5.273e-02 9.062e-02 1.623e-01 1.419e-01 2.500e+00 1.020e+02
```

2.4. EPI

Original Density / Box plot

321

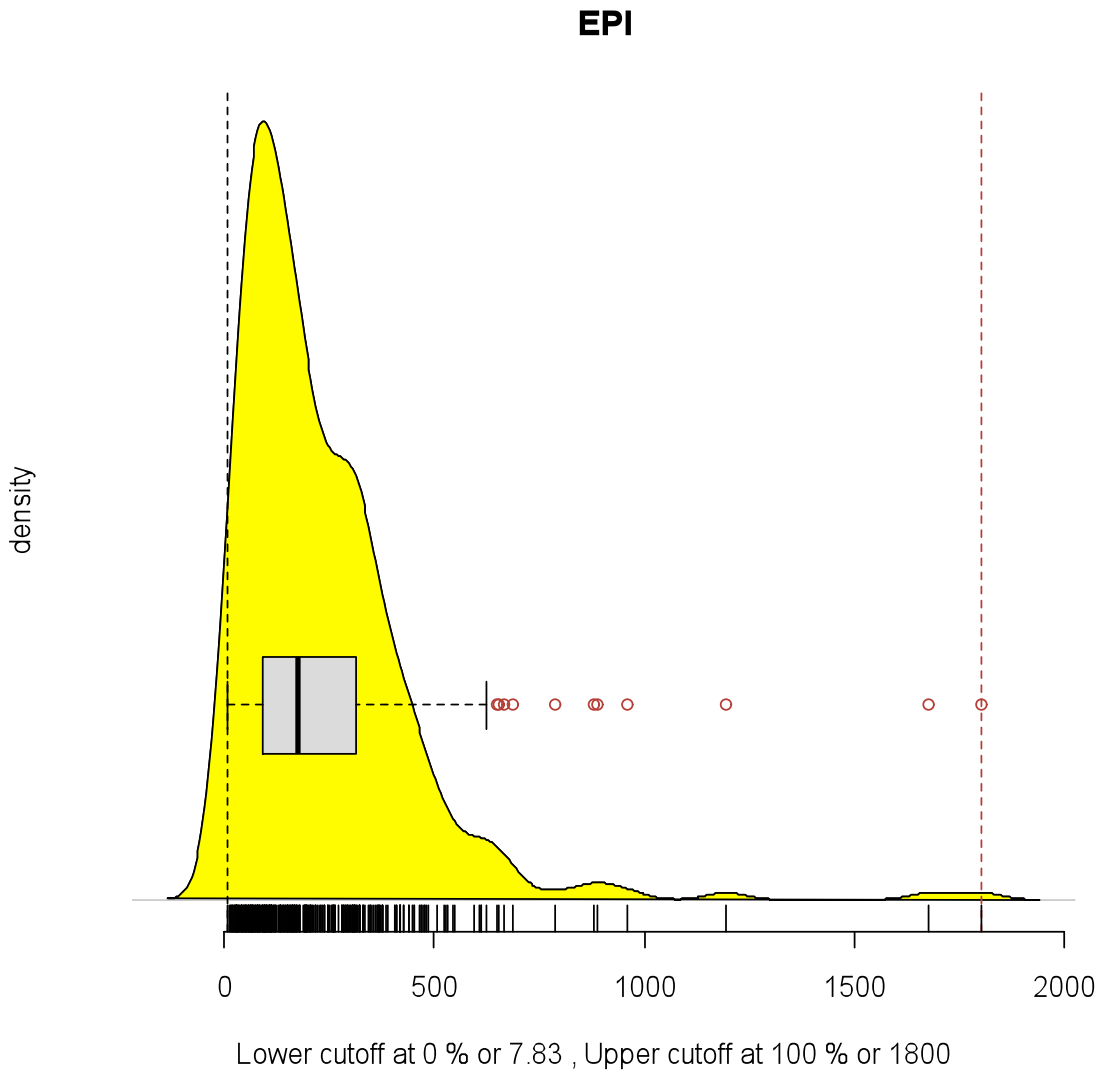


Figure 2-3

```
Original
    Min.  1st Qu.   Median     Mean  3rd Qu.     Max.     NA's
   7.834   90.490  171.400  230.300  312.700 1800.000    7.000
```

2.5. EPI per Hour of Operation

Original Density / Box plot

321

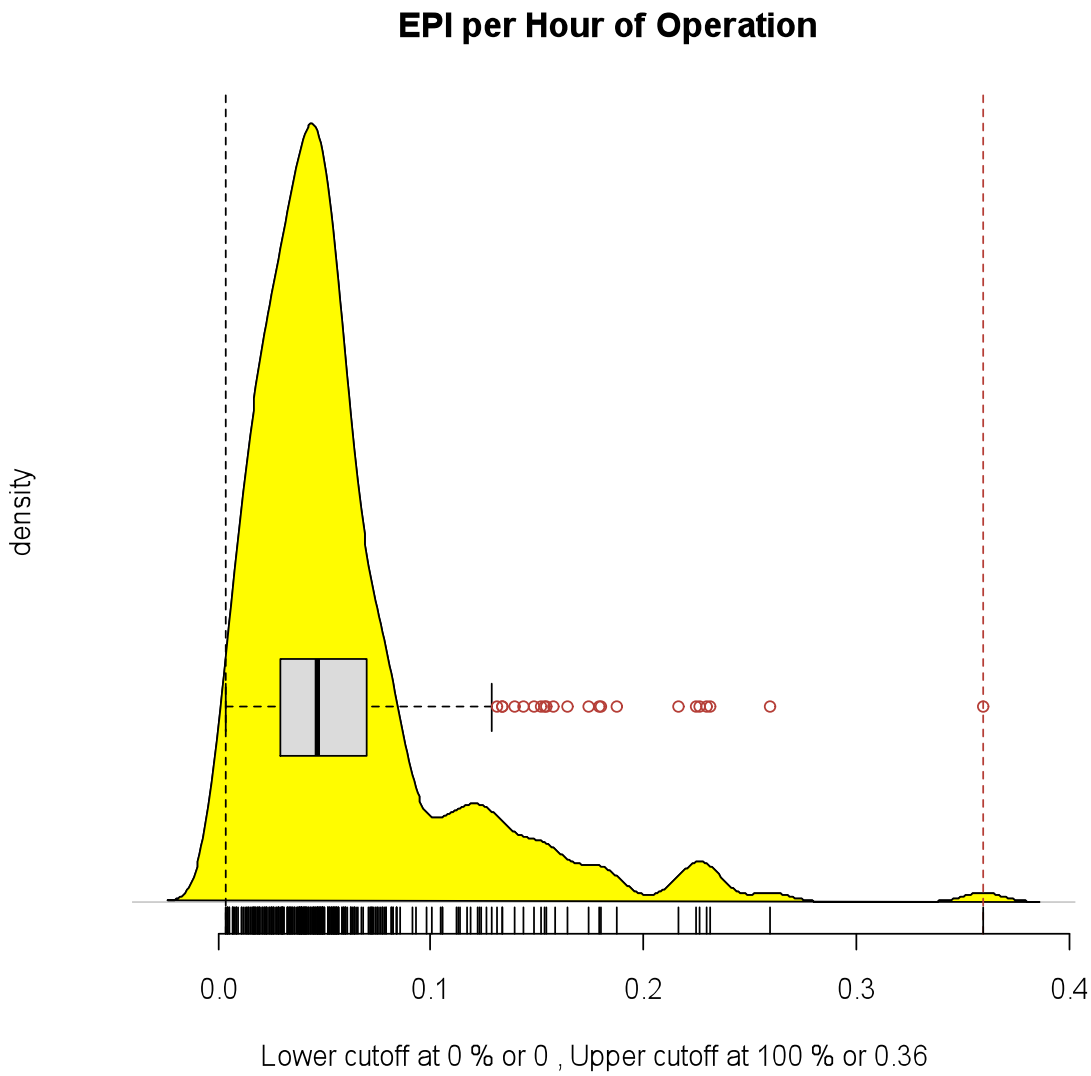


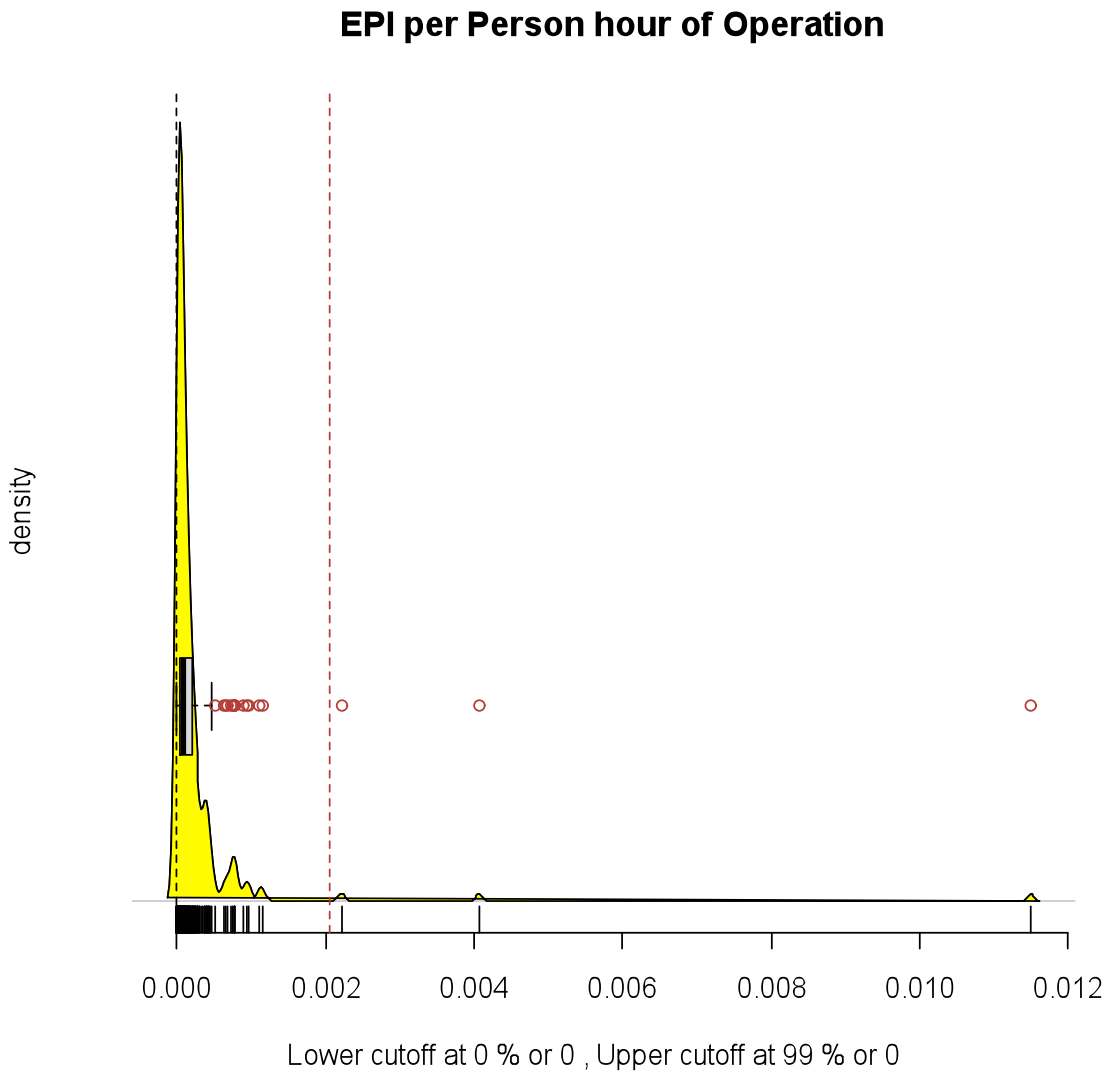
Figure 2-4

```
Original
     Min.   1st Qu.    Median      Mean   3rd Qu.      Max.      NA's
 0.003235  0.028980  0.046780  0.058540  0.069490  0.359600 66.000000
```

2.6. EPI per Person hour of Operation

Original Density / Box plot

321



Remarks: BIDs 166, 272, 354 have very high values compared to other data points

Figure 2-5

```
Original
     Min.   1st Qu.    Median      Mean   3rd Qu.      Max.      NA's
1.081e-06 3.104e-05 8.584e-05 2.681e-04 2.159e-04 1.150e-02 1.020e+02
```

2.7. BUA

Original Density / Box plot	Data count
Observation: bua = 1,101,654 sq mts, Building not yet occupied	320
BIDs: 236	
Action: Observation dropped	

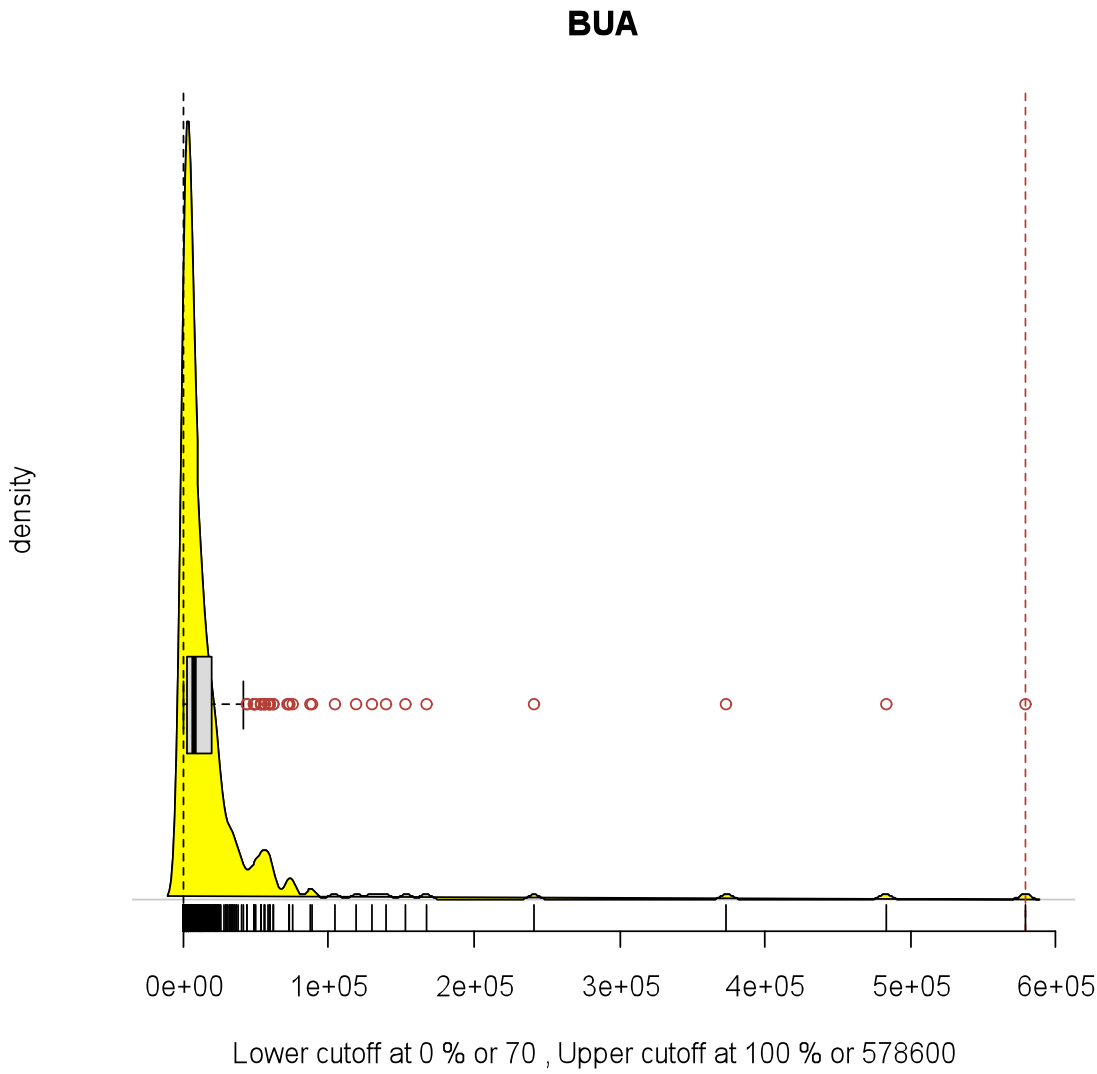


Figure 2-6

```
Original
Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NA's
  70    2686    7466   24210   19360 1102000       1
Modified
Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NA's
  70    2673    7432   20830   19220  578600       1
```

2.8. EMP

Original Density / Box plot	Data count
	320

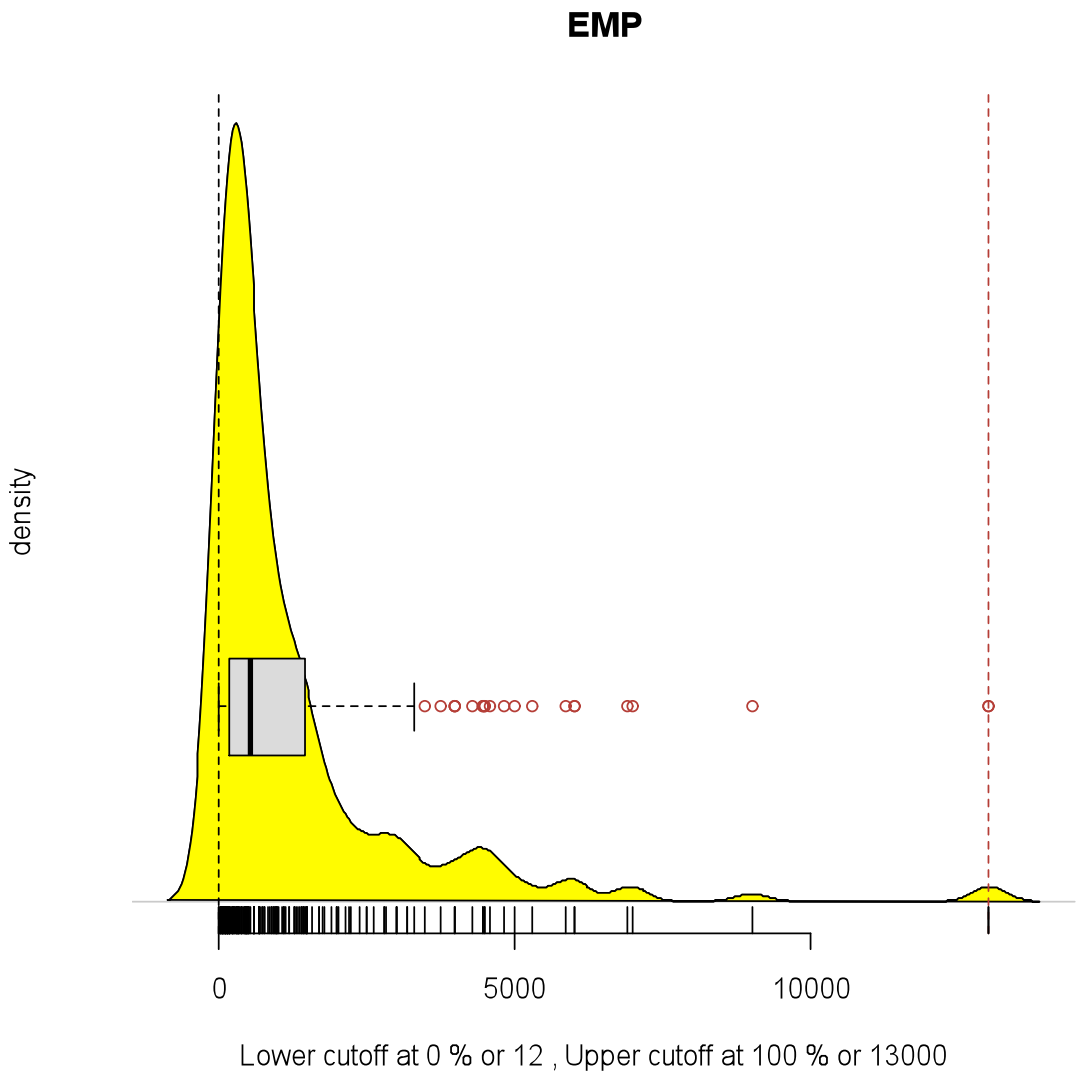


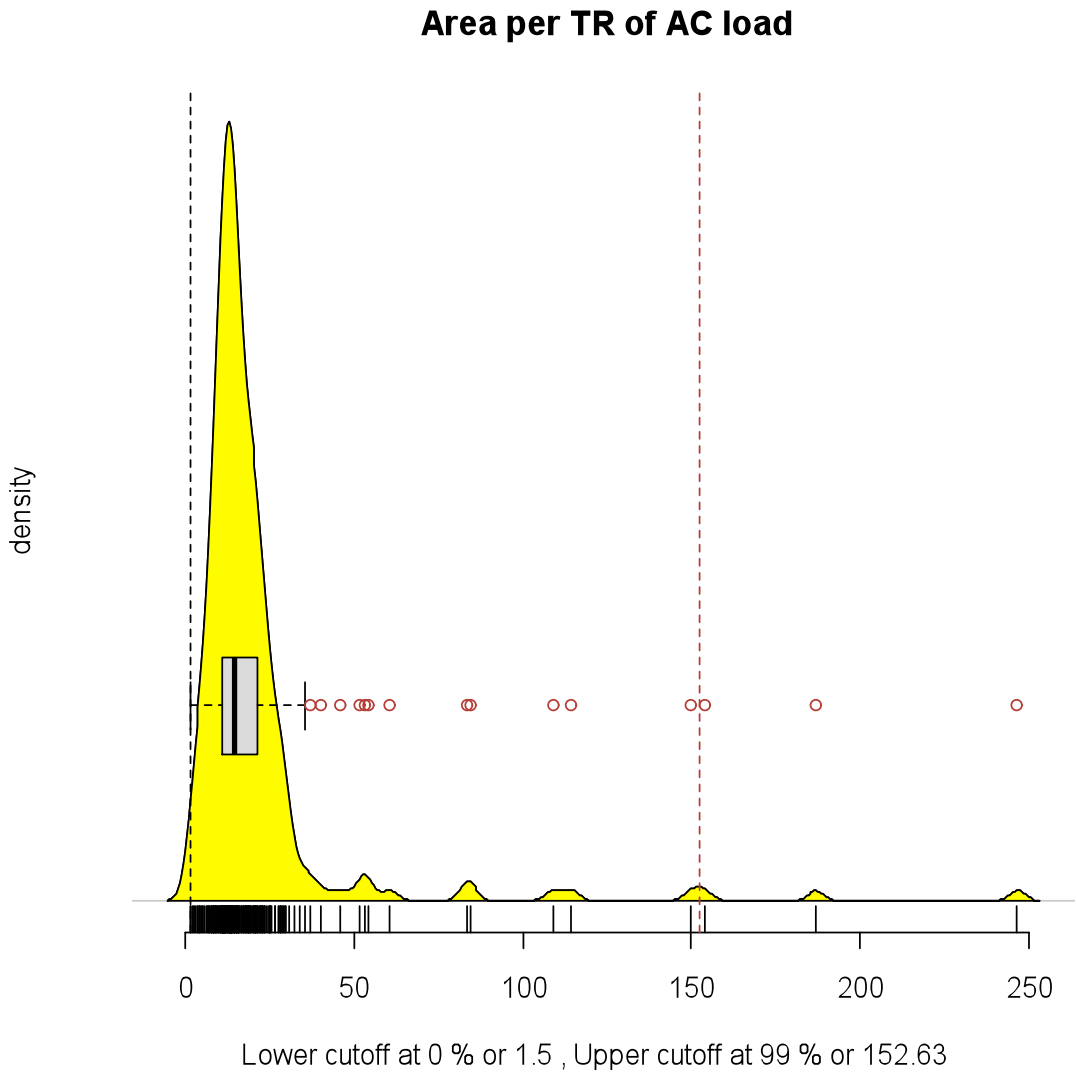
Figure 2-7

```
Original
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NA's
   12.0   209.0   540.5  1278.0  1461.0 13000.0   100.0
```

2.9. Area per TR of AC

Original Density / Box plot **Data count**

ar.tr = car.con / tot.tr



Observations: area per TR of AC > 152.63 320
BIDs: 384 385 426
Action: tot.tr and car.con information set to 'NA'
Figure 2-8

```
Original
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NA's
   1.50   11.20   14.82   20.66   21.15  246.60   86.00
Modified
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NA's
   1.50   11.15   14.69   18.39   20.95  150.00   89.00
```

2.10.Final Summary

No. of observations = 320

	Var. name	obs.	mean	median	s.d.	min.	max.
3	epi	311	232.58	175.79	214.49	7.83	1800
4	epi.p.h	216	0	0	0	0	0.01
5	epi.h	255	0.06	0.05	0.05	0	0.36
10	elec.pur	257	3514659.16	1390550	6497047.83	6000	48600000
11	elec.dg	209	504322.62	60000	2097736.8	0	27893589
12	kwh	312	3644081.2	1418278	6591820.34	6000	48924000
13	con.load	211	1311.03	612.5	1892.31	19	11500
14	con.dem	187	1480.23	850	1759.25	16	11000
15	dg	221	1735.87	700	2353.48	0	13840
16	elec.pur.cost	250	19319461.14	7639631	34675709.79	52632	291600000
17	elec.dg.cost	216	7206255.66	507914	31139617.91	0	295488000
18	elec.cost	257	26391559.28	8350000	69116170.68	52632	933768286
19	bua	319	20829.34	7432	52678.1	70	578600
20	car.con	273	11125.28	3788	17994.85	15	111480
21	floors	126	7.48	6	6.45	1	47
22	pac2	273	0.69	0.75	0.26	0	1
24	empden	219	0.16	0.09	0.29	0.01	2.5
29	hrs	257	4396.14	3128.57	2494.34	2008	8760
30	hrs.day	279	13.56	10	6.21	8	24
31	days.week	257	5.79	6	0.85	4.81	7
33	emp	220	1278.39	540.5	1874.61	12	13000
34	occup	188	1044.06	427.5	1588.9	16	13000
41	tot.tr	262	641.29	300	849.91	2	5722
42	ar.tr	231	18.39	14.69	16.49	1.5	150
43	bua.emp	219	15.99	11.03	15.91	0.4	108.52

Table 2-2:

2.10.1. Subtype

BPO 91

2.10.2. Climatic Zones and Conditioning status

No. of observations	Conditioned	Unconditioned	NA	Total
Cold	1	2	0	3
Composite	77	25	24	126
Hot & Dry	16	3	2	21
Temperate	37	6	4	47
Warm & Humid	102	4	17	123
Total	223	40	47	320

Table 2-3:

2.10.3. Ownership

No. of observations	Conditioned	Unconditioned	NA	Total
Private	183	18	30	231
Public	50	22	17	89
Total	233	40	47	320

Table 2-4:

2.10.4. Shifts

1 shift	2 shifts	3 shifts	<NA>
102	114	63	41

Table 2-5:

2.11.General Profile of Office Buildings

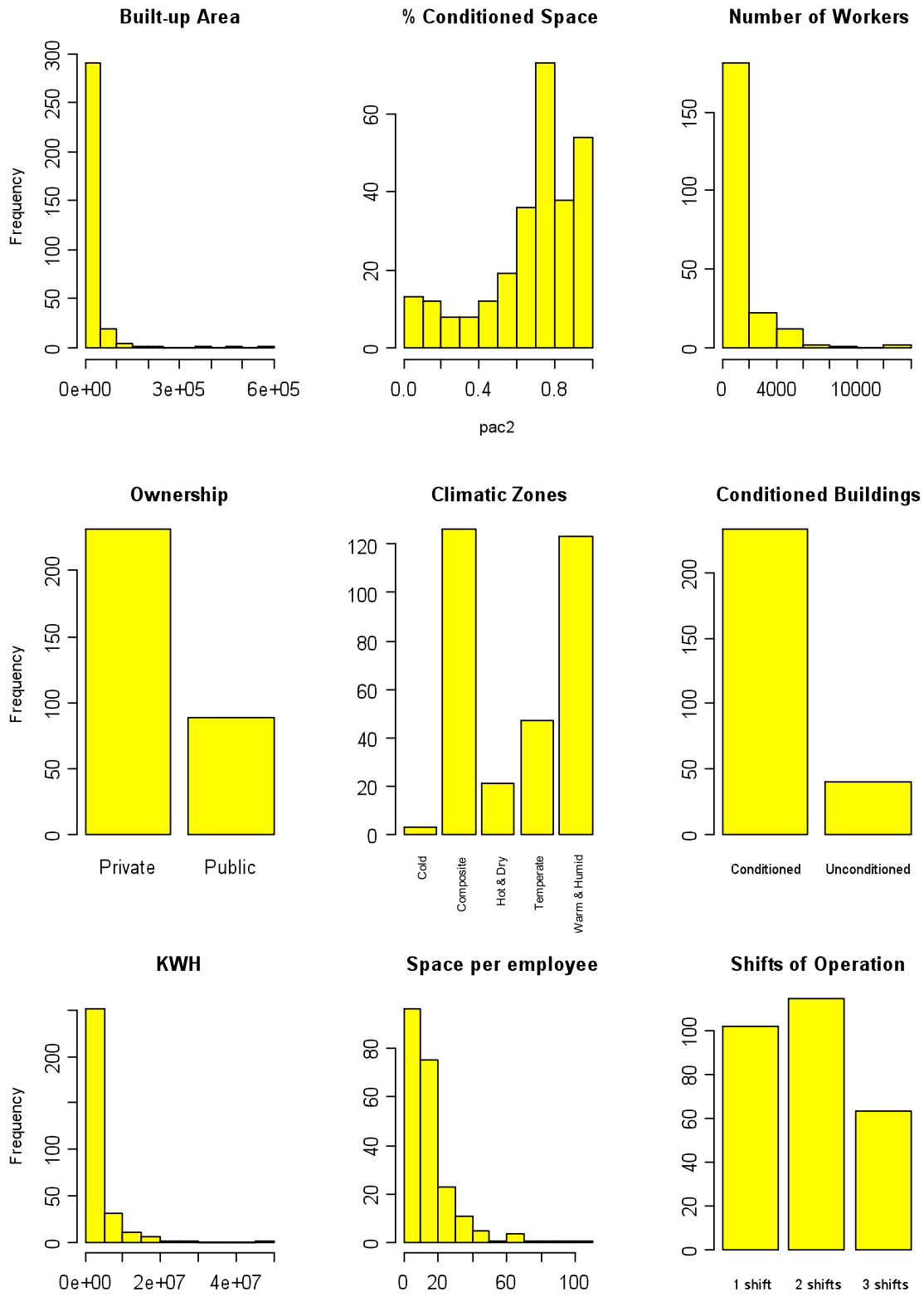


Figure 2-9

2.12.EPI

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	NA's
7.834	93.460	175.800	232.600	314.400	1800.000	9.000

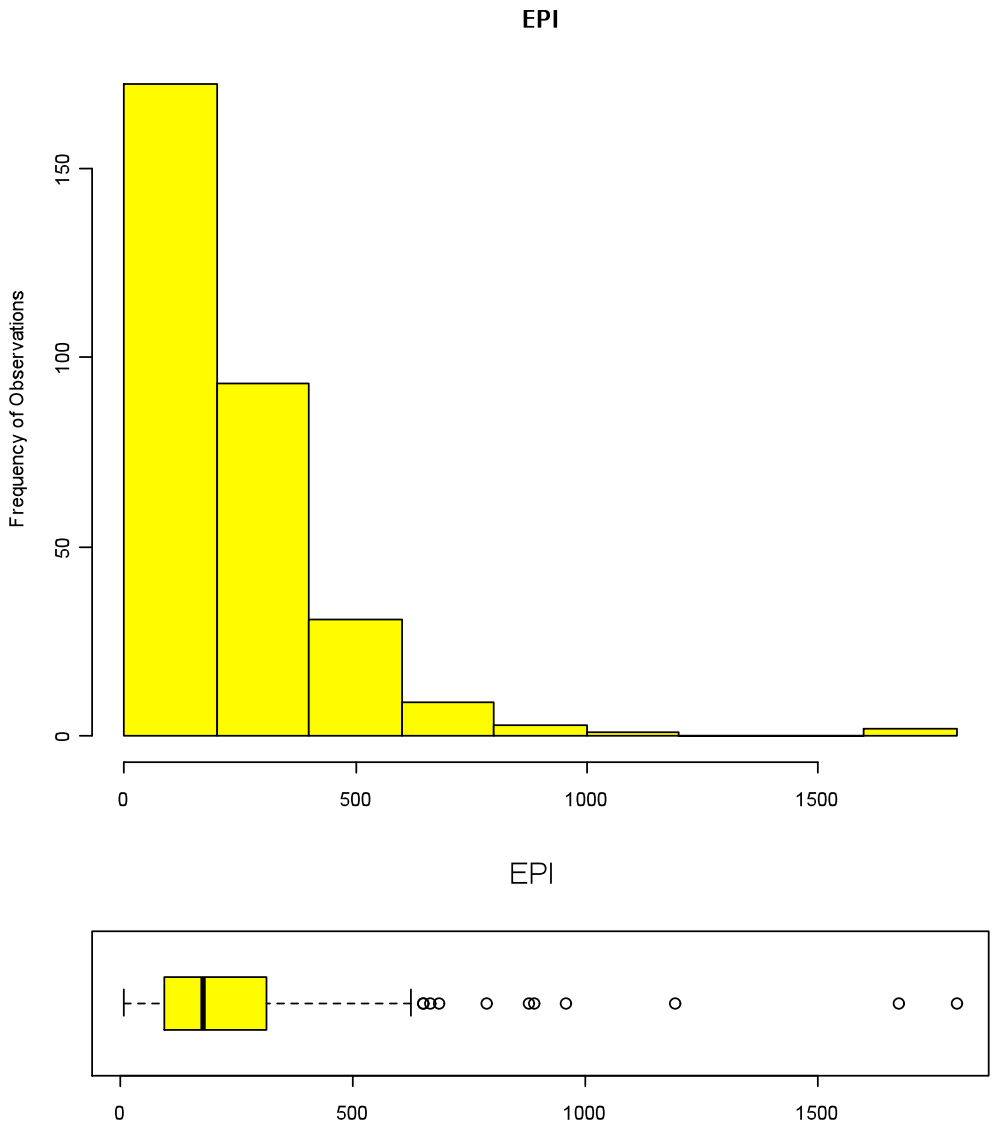


Figure 2-10

2.12.1. EPI per Hour of Operation

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	NA's
0.003235	0.029660	0.046990	0.058820	0.070550	0.359600	67.000000

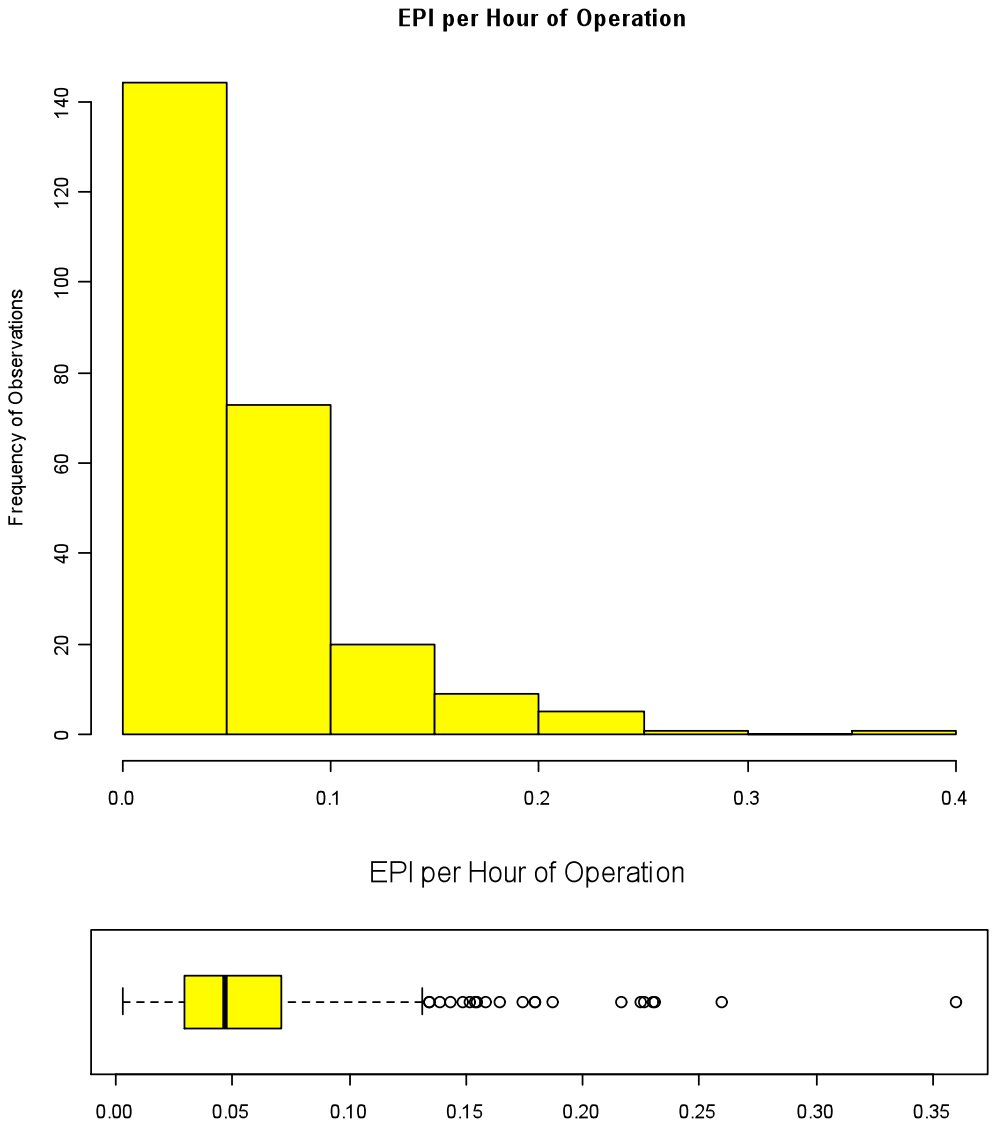


Figure 2-11

2.12.2. Ownership and EPI

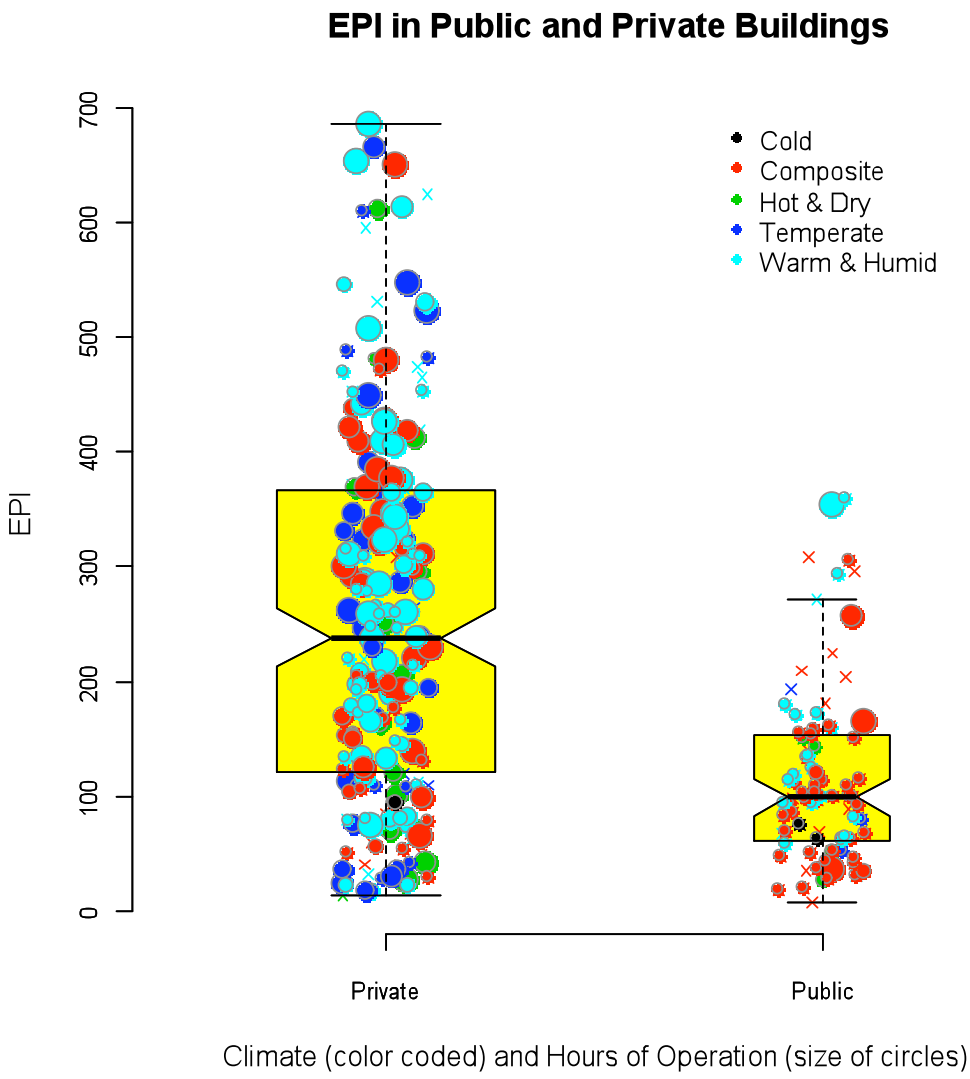


Figure 2-12. Note: Outliers in the above graph are removed for presentation purpose only

EPI	count	mean	median	sd	min	max
1 Cond	226	264.90	212.69	207.2	22.533	1800.0
2 Uncond	39	90.53	52.31	109.5	14.043	613.3
3 Pvt	224	273.03	238.48	224.9	14.043	1800.0
4 Pub	87	128.43	99.11	139.6	7.834	1194.6

EPI		count	mean	median	sd	min	max
1 Cond	Pvt	177	296.05	262.94	207.11	22.53	1800.0
2 Uncond	Pvt	18	115.56	72.77	144.92	14.04	613.3
3 Cond	Pub	49	152.38	113.62	165.92	27.21	1194.6
4 Uncond	Pub	21	69.08	50.97	62.19	20.50	308.8

Table 2-6:

2.12.3. Ownership and EPI per Hour of Operation

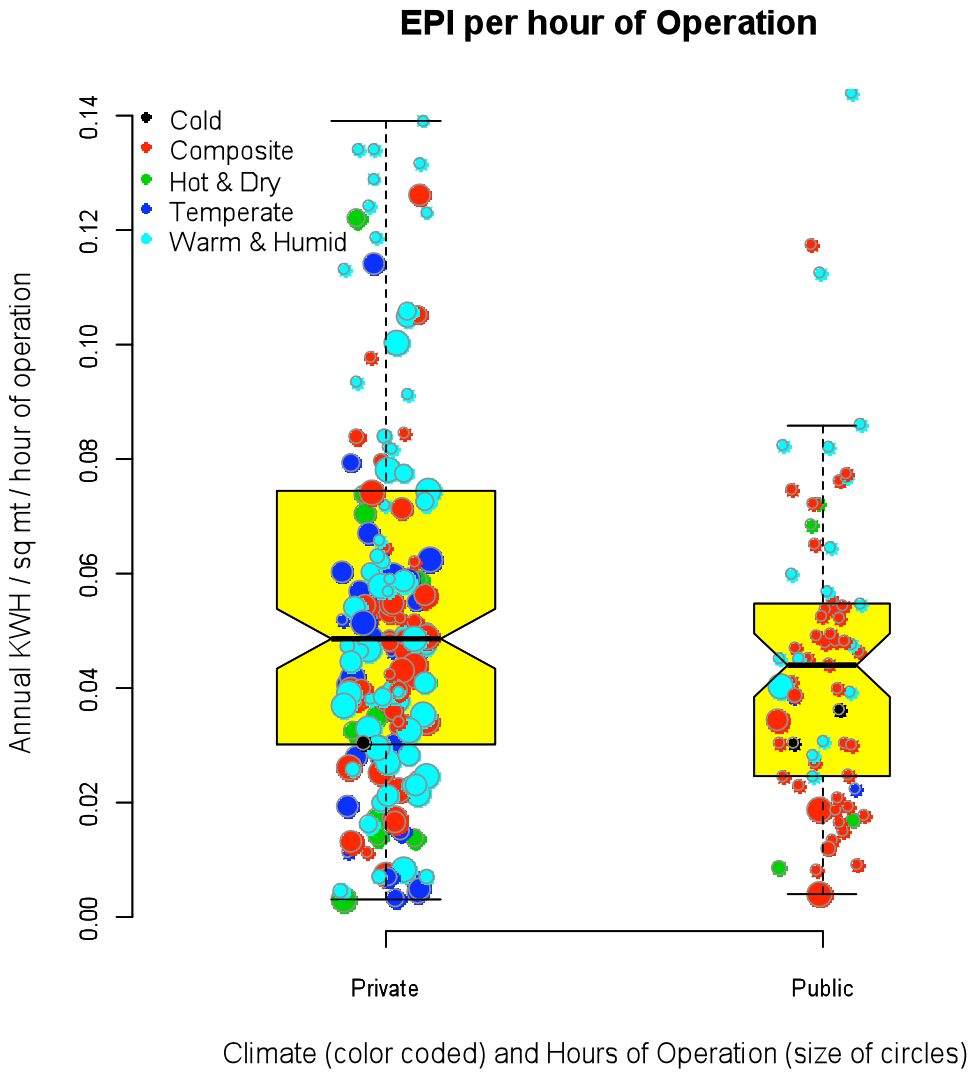


Figure 2-13

EPI per hour	count	mean	median	sd	min	max
1 Cond	196	0.063	0.049	0.050	0.0032	0.36
2 Uncond	29	0.027	0.023	0.021	0.0033	0.11
3 Pvt	184	0.064	0.049	0.055	0.0032	0.36
4 Pub	71	0.045	0.044	0.027	0.0043	0.14

EPI per hour	count	mean	median	sd	min	max
1 Cond Pvt	154	0.065	0.049	0.055	0.0032	0.360
2 Uncond Pvt	9	0.029	0.017	0.031	0.0033	0.105
3 Cond Pub	42	0.054	0.049	0.026	0.0087	0.144
4 Uncond Pub	20	0.027	0.024	0.015	0.0043	0.072

Table 2-7:

2.12.4. Conditioned Building and EPI

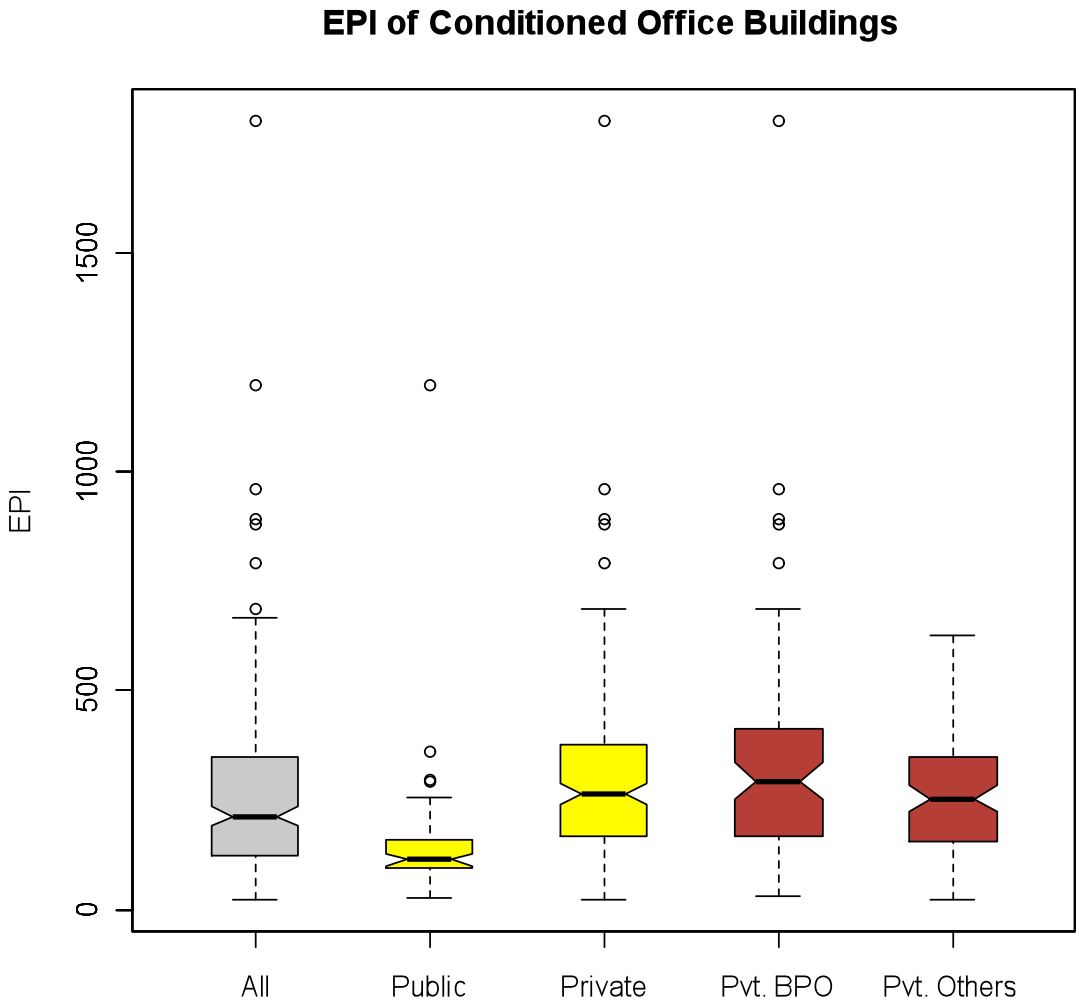


Figure 2-14

EPI of Conditioned Office Buildings

	obs.	mean	median	s.d.	min.	max.
All	226	264.902	212.691	207.24	22.533	1800
Public	49	152.38	113.62	165.92	27.209	1194.628
Private	177	296.052	262.942	207.11	22.533	1800
Private BPO	83	331.877	291.667	261.03	28.338	1800
Private Others	94	264.419	253.075	137.64	22.533	624.413

Table 2-8:

Median EPI of private office buildings are more than twice that of public office buildings. However, private buildings operate for much larger hours compared to public buildings and this should be taken into consideration while comparing private and public buildings. In the next section, EPI is normalized by hours of operation.

2.12.5. Conditioned Building and EPI per Hour of Operation

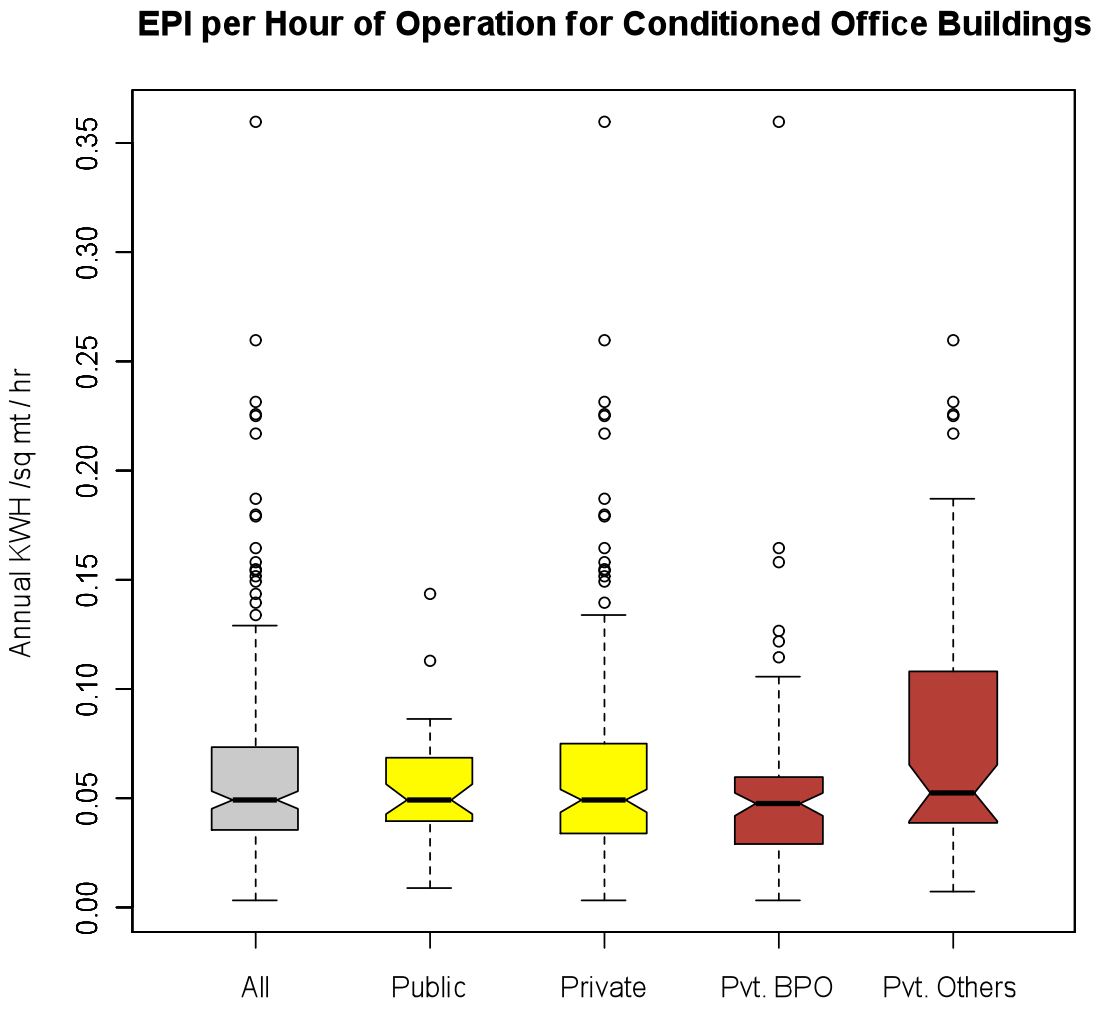


Figure 2-15

EPI per Hour of Conditioned Office Buildings

	obs.	mean	median	s.d.	min.	max.
All	195	0.063	0.049	0.05	0.003	0.36
Public	41	0.055	0.049	0.03	0.009	0.144
Private	154	0.065	0.049	0.06	0.003	0.36

Private BPO	83	0.053	0.047	0.05	0.003	0.36
Private Others	71	0.079	0.052	0.06	0.007	0.26

Table 2-9:

After normalizing for hours of operation, the median EPI for public and private are very similar. Private buildings have larger variation perhaps due to variation in level of service and operating protocols.

EPI per hour of Private non BPO buildings are higher than that of BPOs. Though the difference is not statistically significant, this needs some further investigation.

2.12.6. Climate and EPI

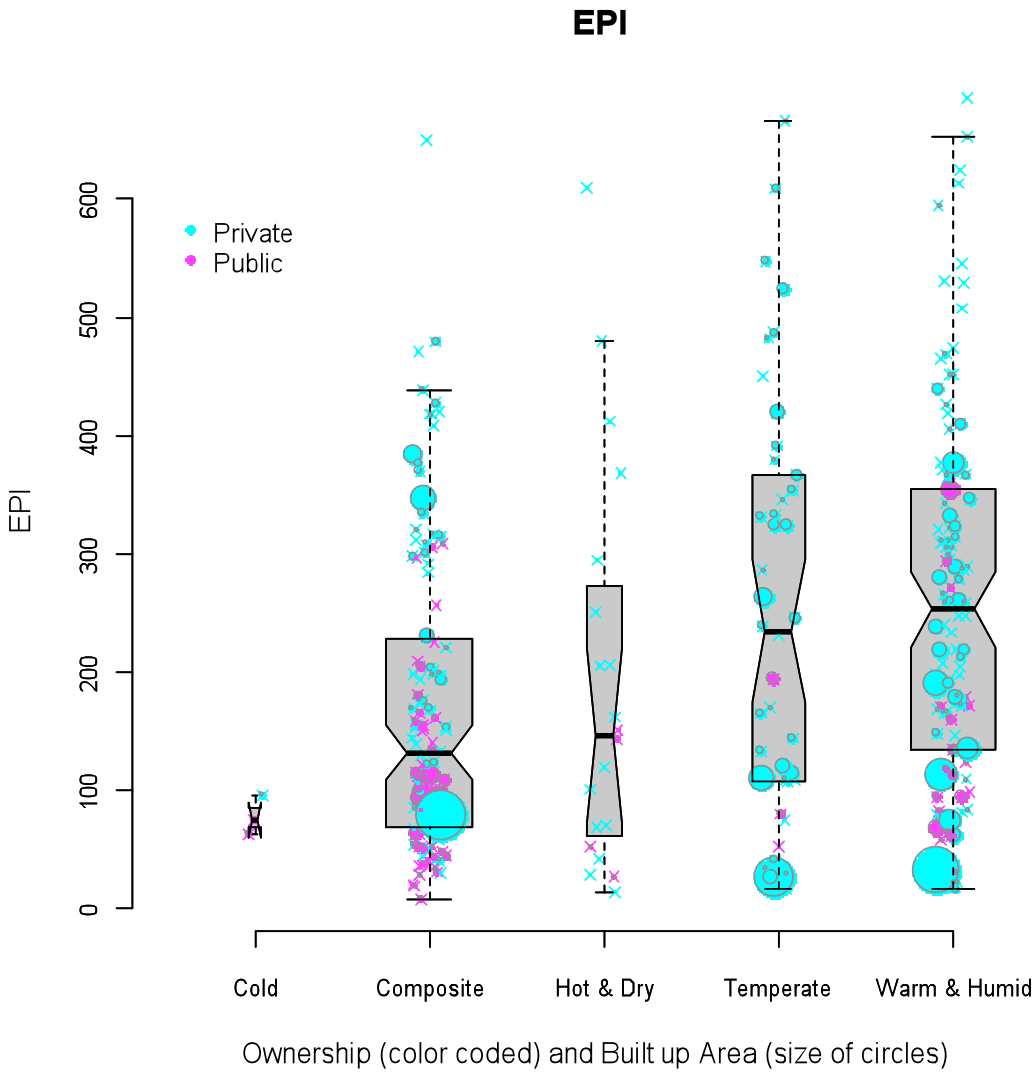


Figure 2-16

EPI

	Group.1	count	mean	median	sd	min	max
1	Cold	3	78.04	75.1	16.40	63.305	95.71
2	Composite	124	183.67	131.8	176.34	7.834	1194.63
3	Hot & Dry	20	190.10	146.6	166.62	14.043	610.00
4	Temperate	46	258.90	234.7	202.18	16.667	960.00
5	Warm & Humid	118	284.86	253.1	249.96	17.206	1800.00

	Group.1	Group.2	count	mean	median	sd	min	max
1	Cold	Private	1	95.71	95.71	NA	95.712	95.71
2	Composite	Private	67	231.95	193.37	175.691	28.791	890.00
3	Hot & Dry	Private	16	214.29	183.60	176.815	14.043	610.00
4	Temperate	Private	43	269.38	246.24	204.466	16.667	960.00
5	Warm & Humid	Private	97	314.55	279.35	263.107	17.206	1800.00
6	Cold	Public	2	69.20	69.20	8.339	63.305	75.10
7	Composite	Public	57	126.92	98.00	160.794	7.834	1194.63
8	Hot & Dry	Public	4	93.31	97.78	62.501	27.209	150.49
9	Temperate	Public	3	108.69	79.99	74.962	52.312	193.76
10	Warm & Humid	Public	21	147.69	118.43	95.932	31.250	359.41

Median EPI	All	Private	Public
Cold	75.1	95.71	69.20
Composite	131.8	193.37	98.00
Hot & Dry	146.6	183.60	97.78
Temperate	234.7	246.24	79.99
Warm & Humid	253.1	279.35	118.43

Table 2-10:

2.12.7. Climate and EPI per Hour of Operation

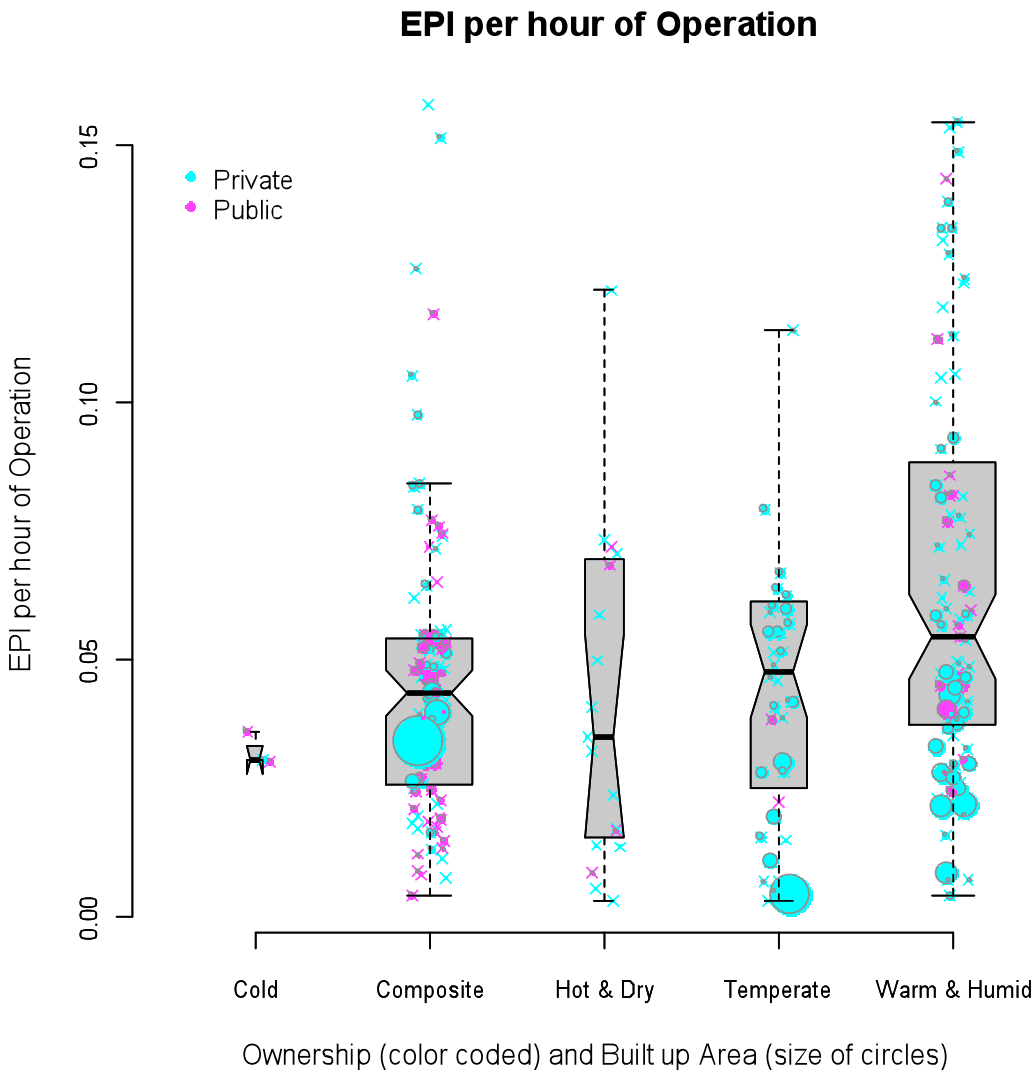


Figure 2-17

EPI per hour of Operation

	Group.1	count.	mean.	median.	sd.	min.	max.
1	Cold	3	0.032	0.031	0.0032	0.0304	0.036
2	Composite	98	0.048	0.044	0.0336	0.0043	0.226
3	Hot & Dry	19	0.050	0.035	0.0534	0.0032	0.230
4	Temperate	40	0.061	0.048	0.0607	0.0033	0.260
5	Warm & Humid	95	0.071	0.054	0.0552	0.0043	0.360

	Group.1	Group.2	count.	mean.	median.	sd.	min.	max.
1	Cold	Private	1	0.031	0.031	NA	0.0306	0.031
2	Composite	Private	53	0.055	0.047	0.040	0.0076	0.226
3	Hot & Dry	Private	15	0.053	0.035	0.058	0.0032	0.230
4	Temperate	Private	38	0.063	0.050	0.062	0.0033	0.260
5	Warm & Humid	Private	77	0.073	0.054	0.059	0.0043	0.360
6	Cold	Public	2	0.033	0.033	0.004	0.0304	0.036
7	Composite	Public	45	0.040	0.040	0.023	0.0043	0.117
8	Hot & Dry	Public	4	0.042	0.043	0.033	0.0087	0.072
9	Temperate	Public	2	0.030	0.030	0.011	0.0223	0.038
10	Warm & Humid	Public	18	0.062	0.056	0.031	0.0243	0.144

Median EPI/hr	All	Private	Public
Cold	0.031	0.031	0.033
Composite	0.044	0.047	0.040
Hot & Dry	0.035	0.035	0.043
Temperate	0.048	0.050	0.030
Warm & Humid	0.054	0.054	0.056

Table 2-11:

2.12.8. Summary of EPI

Median EPI

		# obs	All	Cold	Composite	Hot & Dry	Temperate	Warm & Humid
All	All	311	176	75	132	147	235	253
	Public	87	99	69	98	98	80	118
	Private	224	238	96	193	184	246	279
	Pvt BPO	91	287		301	162	305	305
	Pvt Other	133	214	96	153	368	144	261
Cond	All	226	213	96	168	143	305	259
	Public	49	114		109	98	137	124
	Private	177	263	96	212	162	323	279
	Pvt BPO	83	292		292	162	327	300
	Pvt Other	94	253	96	198		216	262
Uncond	All	39	52	69	49	101	38	88
	Public	21	51	69	45		52	64
	Private	18	73		78	101	35	113
	Pvt BPO	5	101			153	26	613
	Pvt Other	13	68		78	14	41	72

Table 2-12:

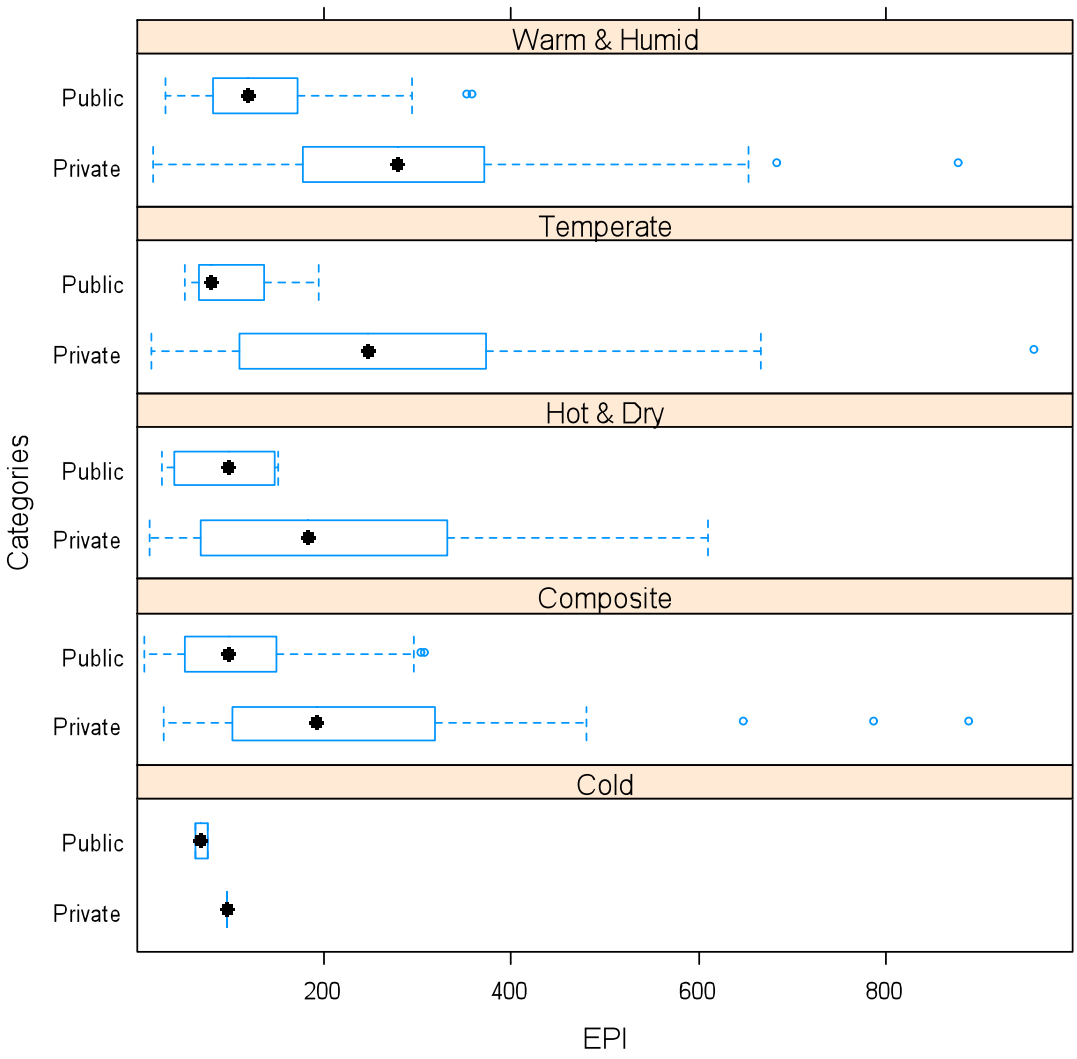

Warm & Humid
Public
Private
Temperate
Public
Private
Hot & Dry
Public
Private
Composite
Public
Private
Cold
Public
Private
Categories
200
400
600
800
EPI

Figure 2-18

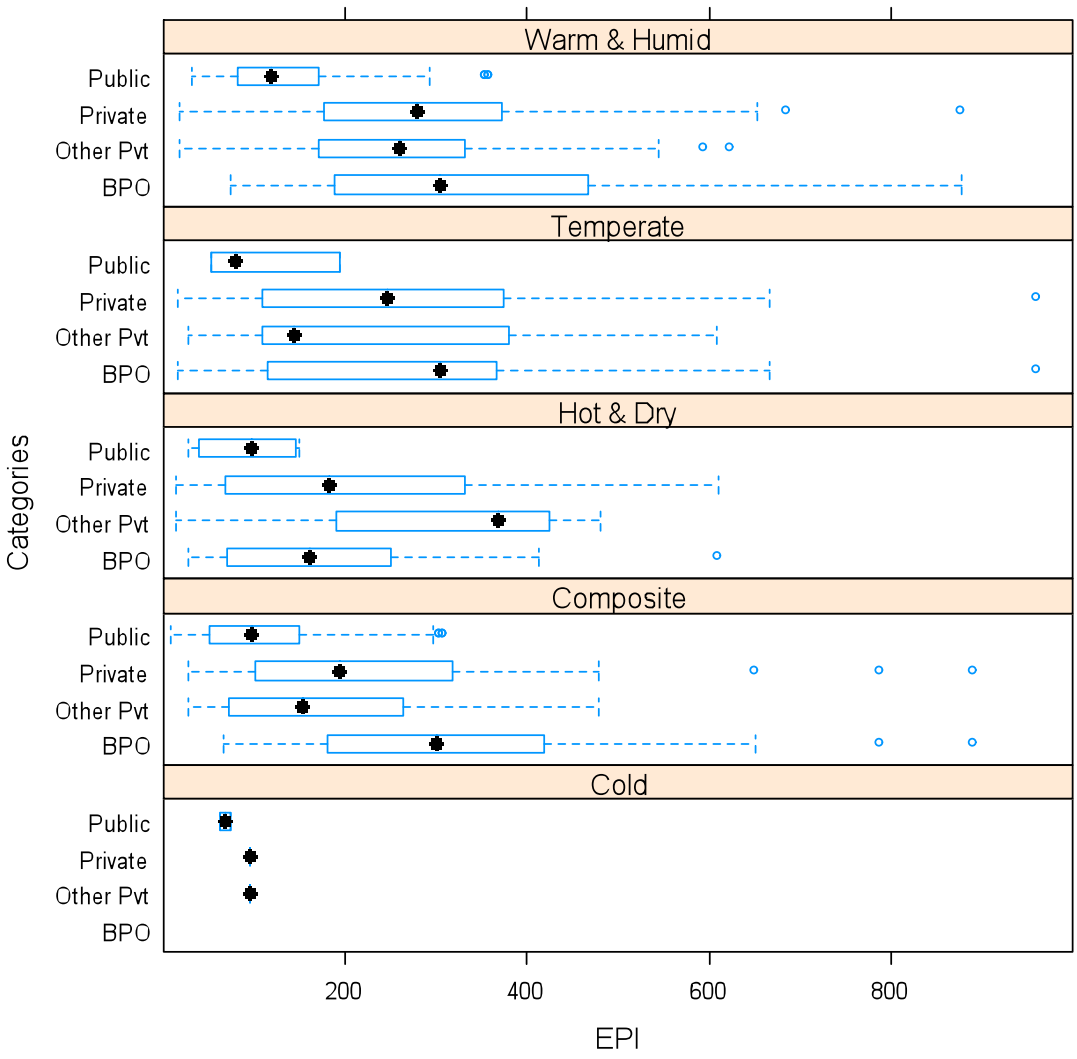

Warm & Humid
Temperate
Hot & Dry
Composite
Cold
Public
Private
Other Pvt
BPO
Categories
200
400
600
800
EPI

Figure 2-19

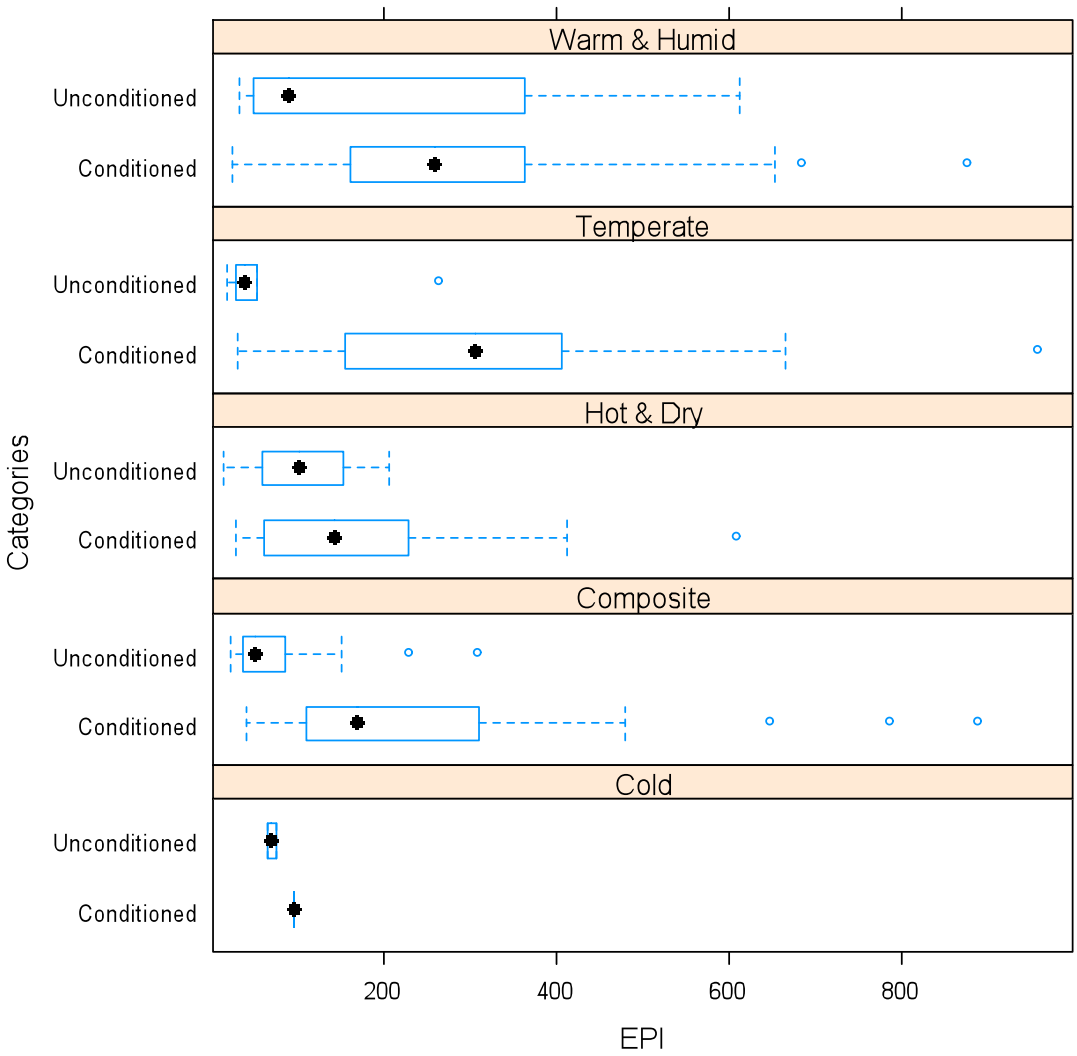

Warm & Humid
Temperate
Hot & Dry
Composite
Cold
Unconditioned
Conditioned
Categories
200
400
600
800
EPI

Figure 2-20

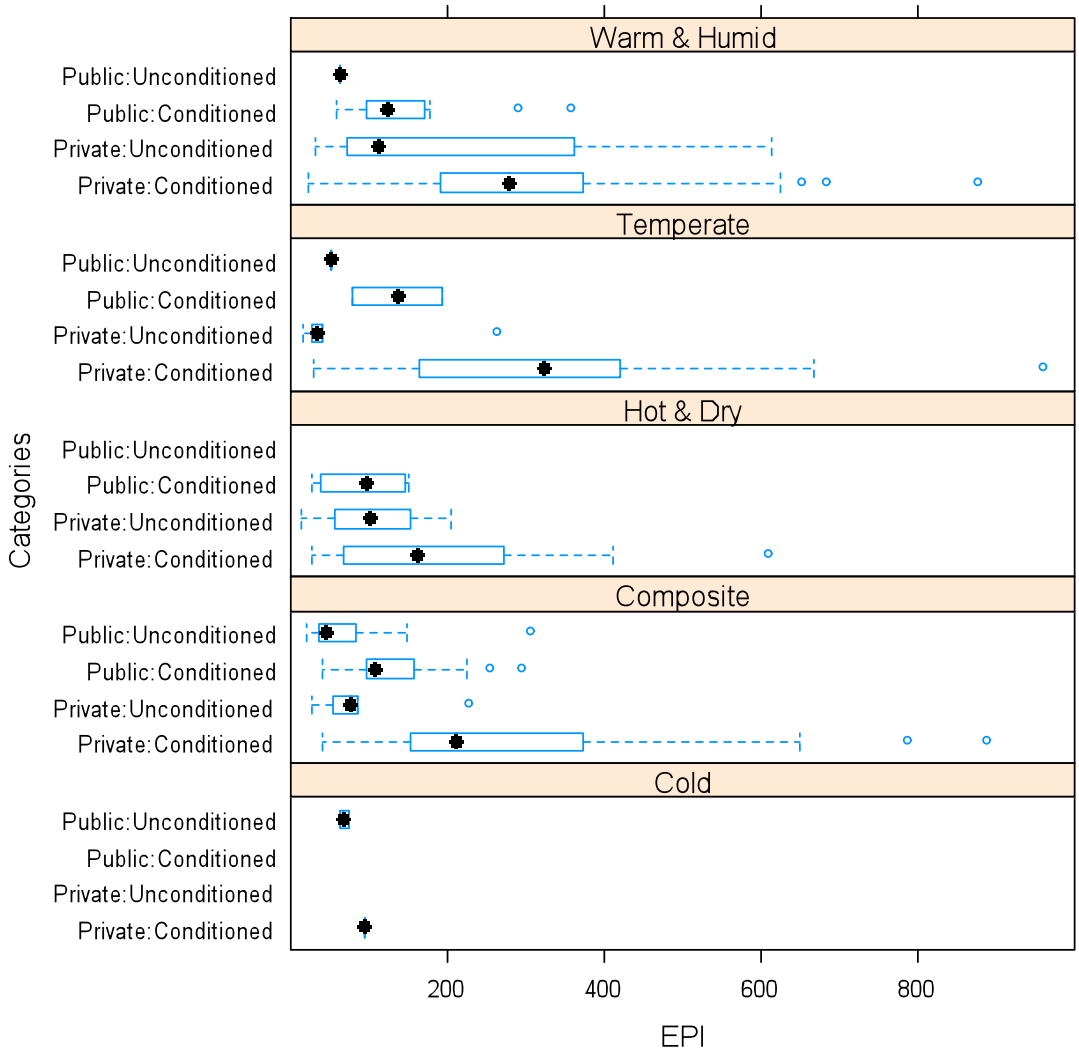

Warm & Humid
Temperate
Hot & Dry
Composite
Cold
Public:Unconditioned
Public:Conditioned
Private:Unconditioned
Private:Conditioned
Categories
200
400
600
800
EPI

Figure 2-21

2.12.9. Summary of EPI per Hour of Operation

Median EPI per Hour of Operation

		# obs	All	Cold	Composite	Hot & Dry	Temperate	Warm & Humid
All	All	255	0.047	0.031	0.044	0.035	0.048	0.054
	Public	71	0.044	0.033	0.040	0.043	0.030	0.056
	Private	184	0.049	0.031	0.047	0.035	0.050	0.054
	Pvt BPO	91	0.047		0.045	0.032	0.050	0.048
	Pvt Other	93	0.052	0.031	0.049	0.152	0.049	0.062
Cond	All	196	0.049	0.031	0.048	0.032	0.055	0.052
	Public	42	0.049		0.048	0.043	0.038	0.060
	Private	154	0.049	0.031	0.049	0.032	0.055	0.049
	Pvt BPO	83	0.047		0.043	0.032	0.055	0.047
	Pvt Other	71	0.052	0.031	0.052		0.064	0.059
Uncond	All	29	0.023	0.033	0.024	0.029	0.011	0.068
	Public	20	0.024	0.033	0.022		0.022	0.031
	Private	9	0.017		0.030	0.029	0.009	0.105
	Pvt BPO	5	0.017			0.029	0.005	0.105
	Pvt Other	4	0.021		0.030		0.013	

Table 2-13:

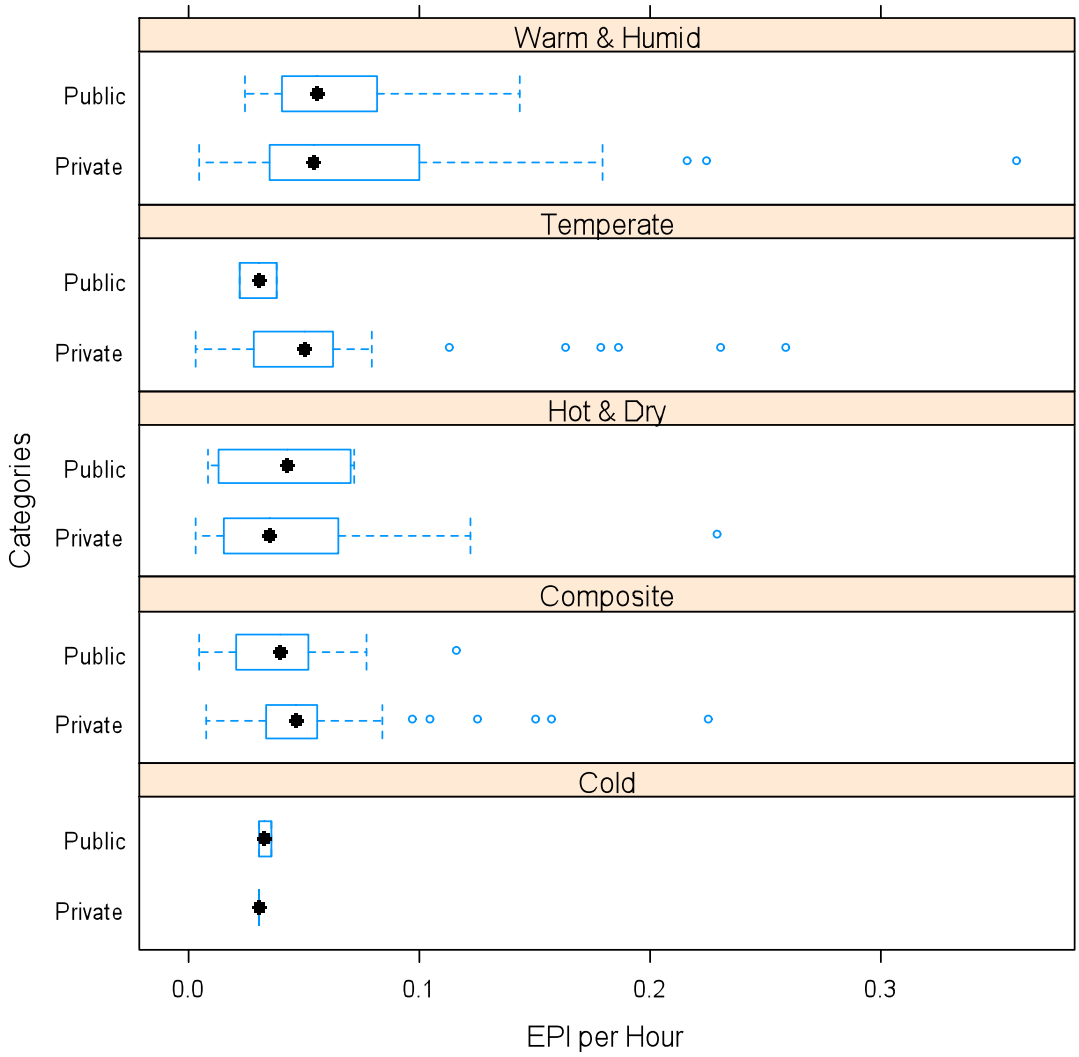

Warm & Humid
Temperate
Hot & Dry
Composite
Cold
Public
Private
Categories
0.0
0.1
0.2
0.3
EPI per Hour

Figure 2-22

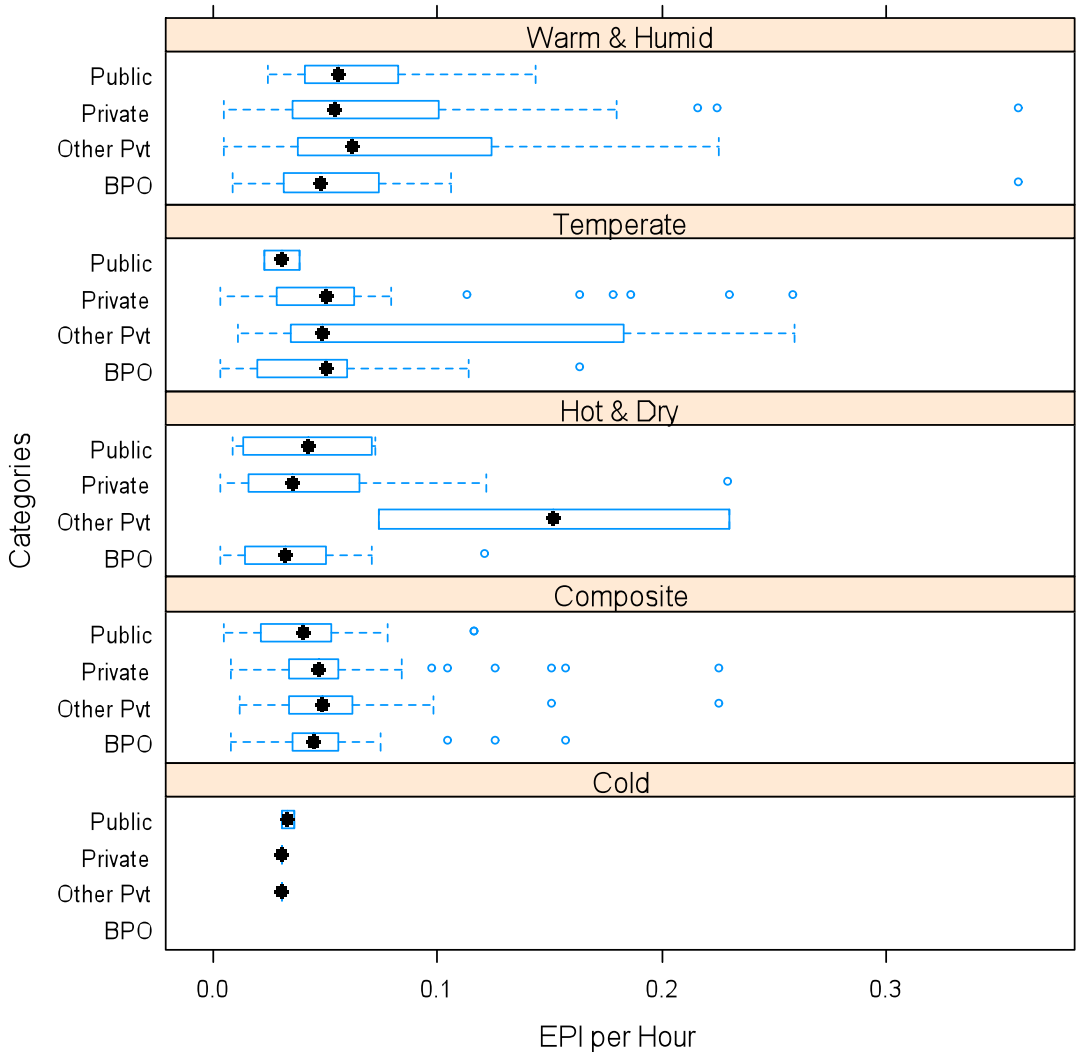

Warm & Humid
Temperate
Hot & Dry
Composite
Cold
Public
Private
Other Pvt
BPO
Categories
0.0
0.1
0.2
0.3
EPI per Hour

Figure 2-23

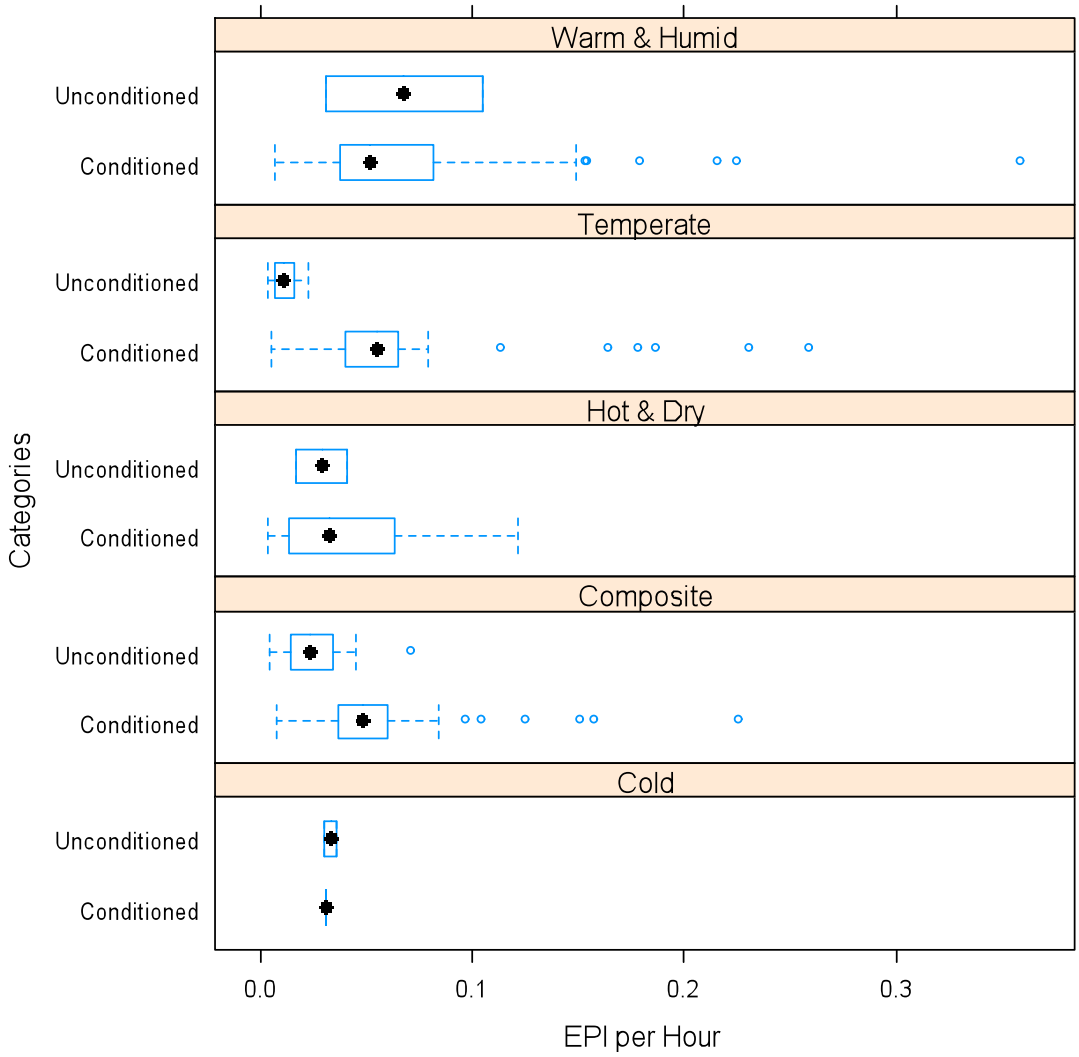

Warm & Humid
Temperate
Hot & Dry
Composite
Cold
Unconditioned
Conditioned
Categories
0.0
0.1
0.2
0.3
EPI per Hour

Figure 2-24

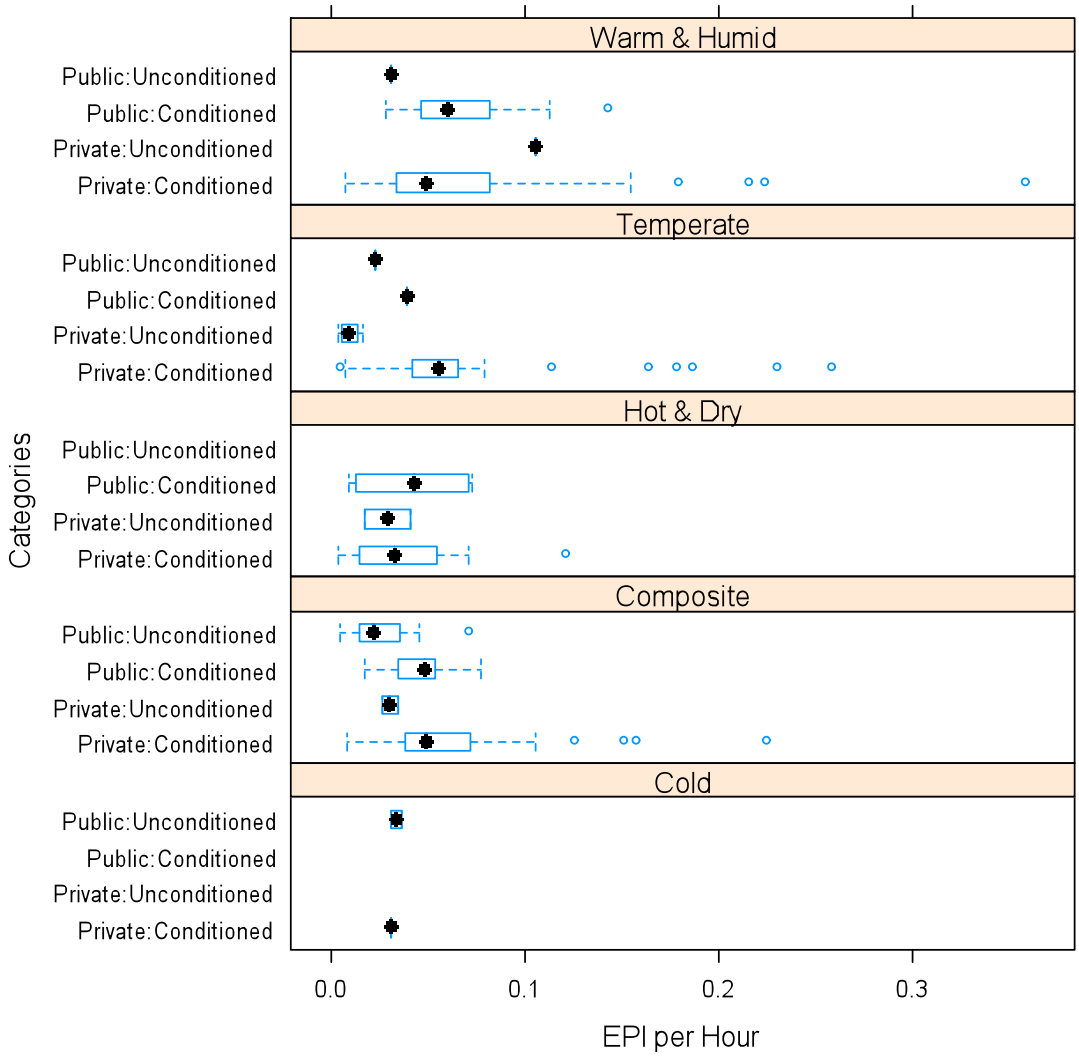

Warm & Humid
Temperate
Hot & Dry
Composite
Cold
Public:Unconditioned
Public:Conditioned
Private:Unconditioned
Private:Conditioned
Categories
0.0
0.1
0.2
0.3
EPI per Hour

Figure 2-25

3.Sector Specific Data: Hospital

3.1. Initial Summary

No. of observations = 153

	Var. name	obs.	mean	median	s.d.	min.	max.
3	epi	152	362.24	283.33	372.98	20.12	2926.01
4	epi.p.h	94	0	0	0	0	0
5	epi.h	111	0.04	0.04	0.03	0.01	0.21
12	elec.pur	114	2202081.81	1465339	2233824.64	80000	7892000
13	elec.dg	111	68813.13	35444	111347.51	0	9e+05
14	kwh	153	2590130.39	1538222	2965607.34	9150	21283746
15	con.load	125	851.44	500	1533.67	100	13128.55
16	con.dem	25	1022.16	1000	650.73	200	2550
17	dg	19	988.68	900	937.14	65	3000
18	elec.pur.cost	113	12755787.65	7262280	16760249.28	581380	9e+07
19	elec.dg.cost	110	607895.58	284116	955911.84	7130	7200000
20	elec.cost	135	13898566.56	7491874	20955096.91	78271	167184586
21	bua	152	12968.08	4500	25108.89	279	254373
22	car.con	29	11508.17	7993	12724.5	162	50875
23	floors	19	6.58	6	3.52	2	12
24	pac2	28	0.52	0.6	0.33	0.01	1
26	empden	94	0.06	0.05	0.09	0.01	0.9
31	hrs	112	8625.92	8760	824.77	3128.57	8760
32	hrs.day	116	23.56	24	2.27	10	24
33	days.week	112	6.96	7	0.31	4	7
34	shifts	116	1.974	2	0.159	1	2
35	emp	95	276.56	150	341.04	40	1700
40	nbeds	130	244.29	130	309.9	15	1803
41	opd.day	72	174.21	97.5	225.13	25	1500
42	ppatients	7	0.68	0.7	0.2	0.3	0.9
43	tot.tr	50	385.85	312.5	353.88	4.5	1660
44	ar.tr	25	47.53	18.83	122.57	1.86	621.48
45	bua.emp	94	27.94	20.55	22.78	1.11	125
46	bua.bed	130	45.17	32.51	38.52	3.42	208.22
47	emp.bed	91	1.75	1.5	1.06	0.48	5.33

Table 3-1:

3.2. Space per Employee

Original Density / Box plot	Data count
	153

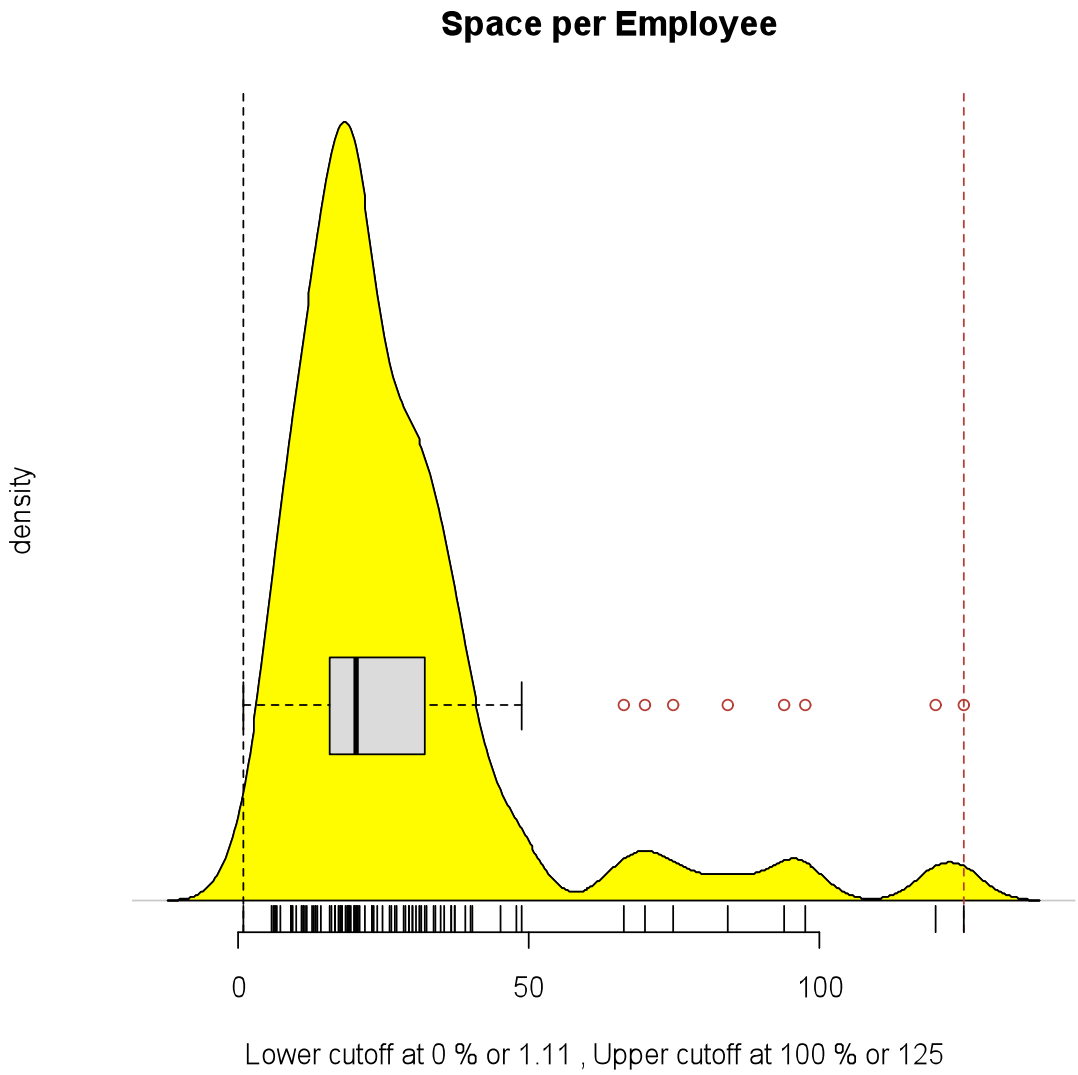
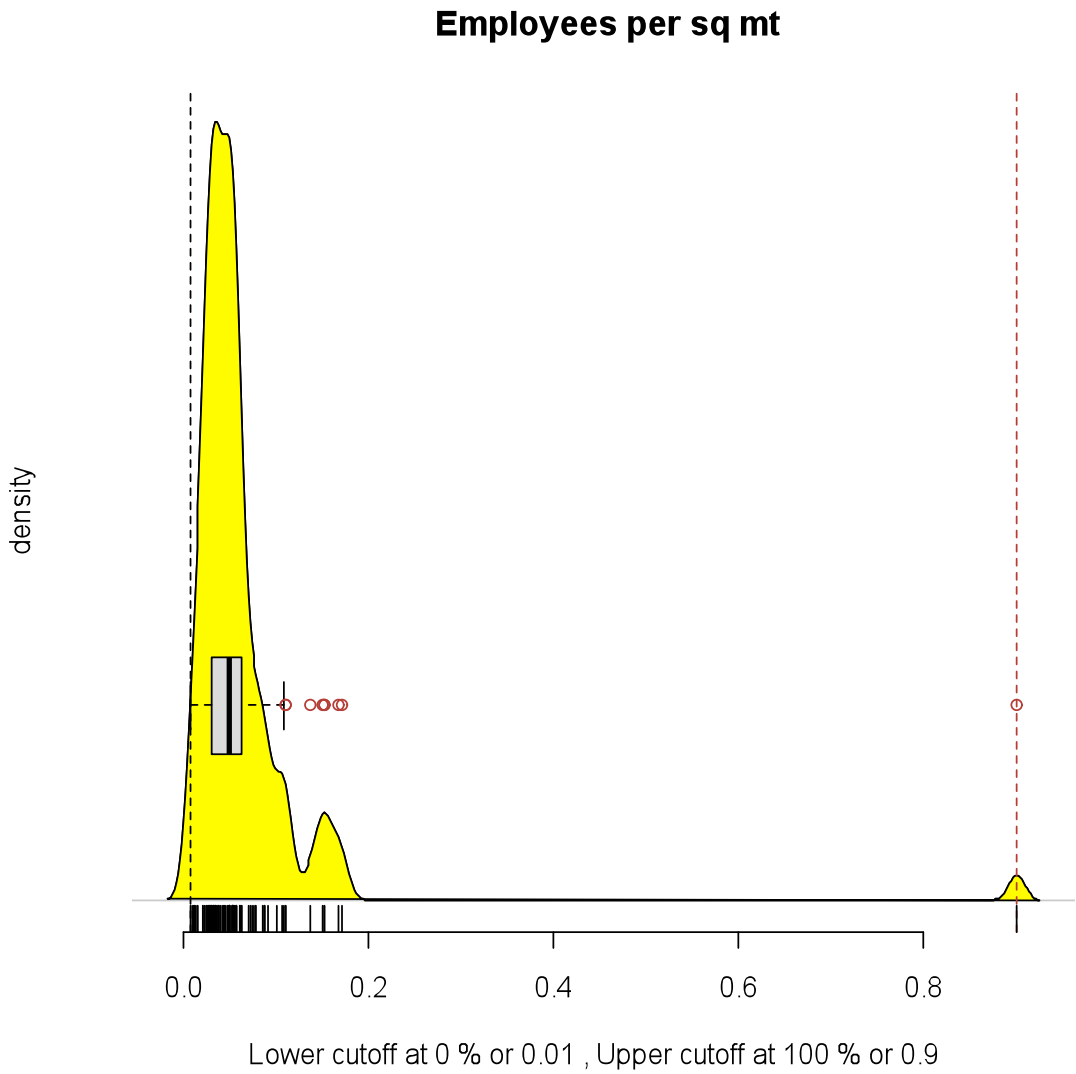


Figure 3-1

```
Original
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NA's
  1.111  16.000  20.550  27.940  32.160 125.000  59.000
```

3.3. Employee per sq mt

Original Density / Box plot	Data count
	153



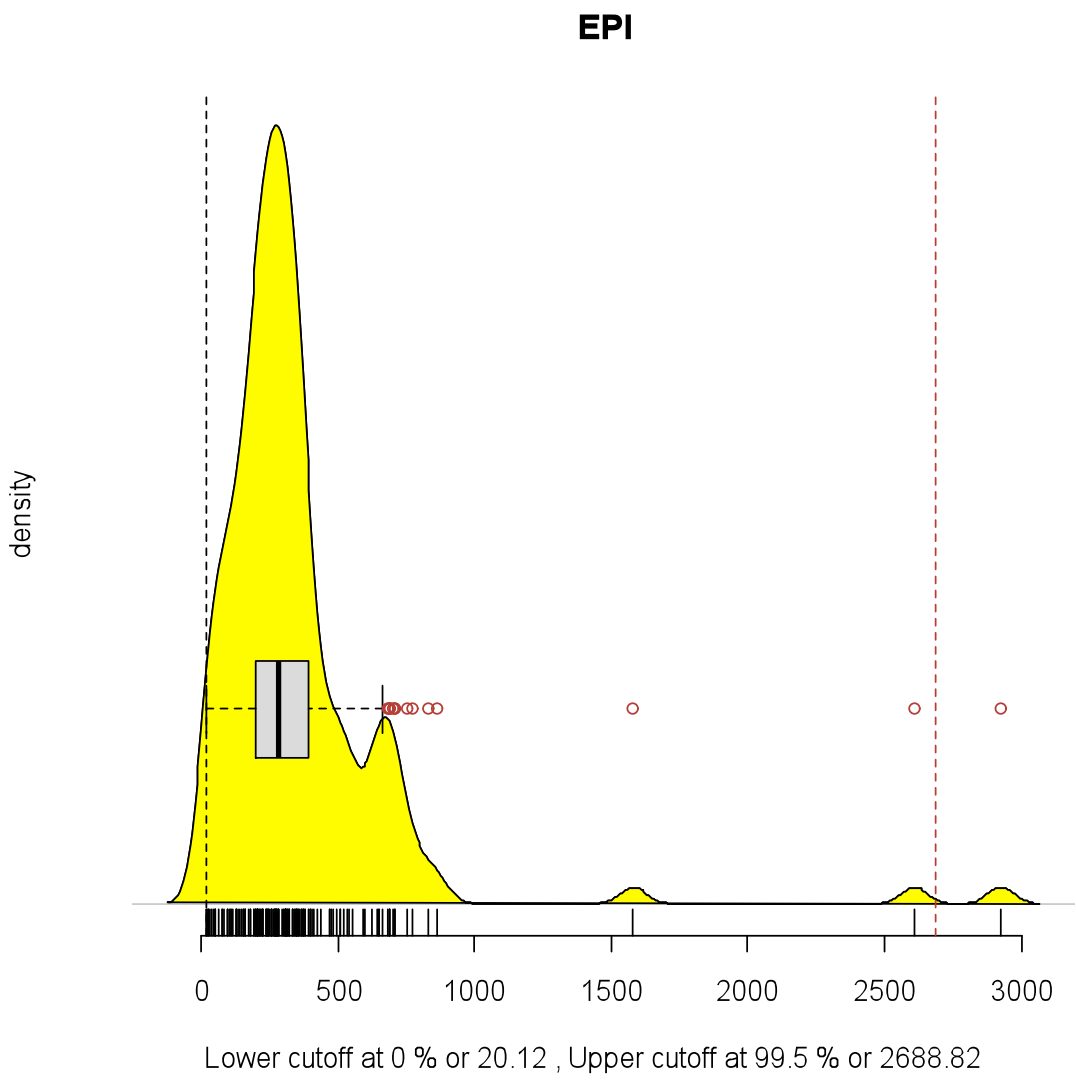
Observation: empden=0.9, BID: 692	153

Action: Set bua and emp to "NA"

Figure 3-2

```
Original
    Min.  1st Qu.   Median     Mean  3rd Qu.     Max.     NA's
 0.00800  0.03110  0.04866  0.06326  0.06250  0.90000 59.00000
Modified
    Min.  1st Qu.   Median     Mean  3rd Qu.     Max.     NA's
 0.00800  0.03091  0.04862  0.05426  0.06250  0.17000 60.00000
```

3.4. EPI

Original Density / Box plot	Data count
	153

Observation: BID 148 152

Action: Dropped from sample (a small nursing home)

Figure 3-3

```
Original
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NA's
  20.12  198.30  281.70  352.20  392.50 2926.00    2.00
Modified
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NA's
  20.12  197.80  280.90  335.10  385.80 2610.00    2.00
```

3.5. EPI per Hour of Operation

Original Density / Box plot	Data count
	152

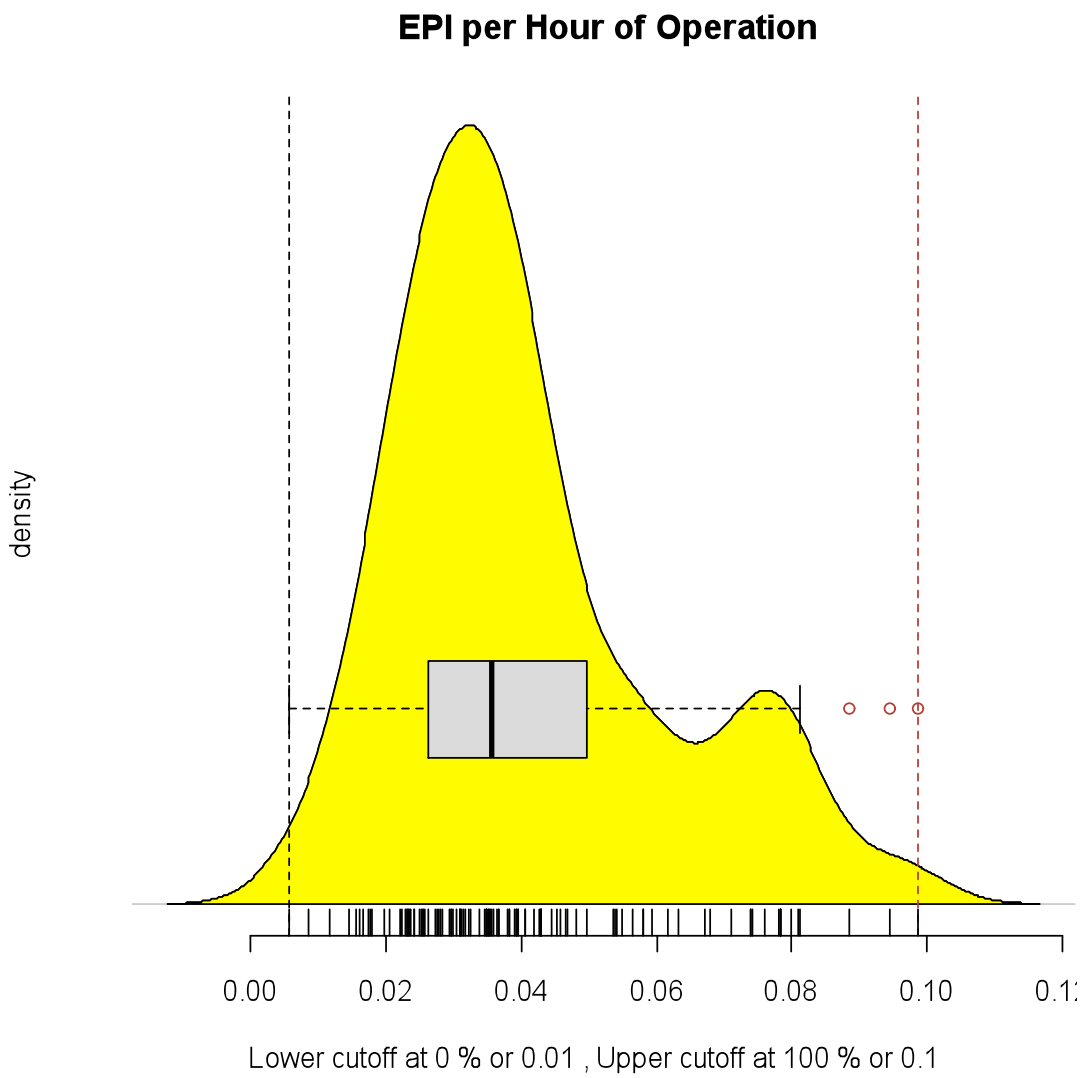


Figure 3-4

```
Original
     Min.   1st Qu.    Median      Mean   3rd Qu.      Max.      NA's
 0.005709  0.026450  0.035490  0.040820  0.049390  0.098740 42.000000
```

3.6. BUA

Original Density / Box plot	**Data count**
	152

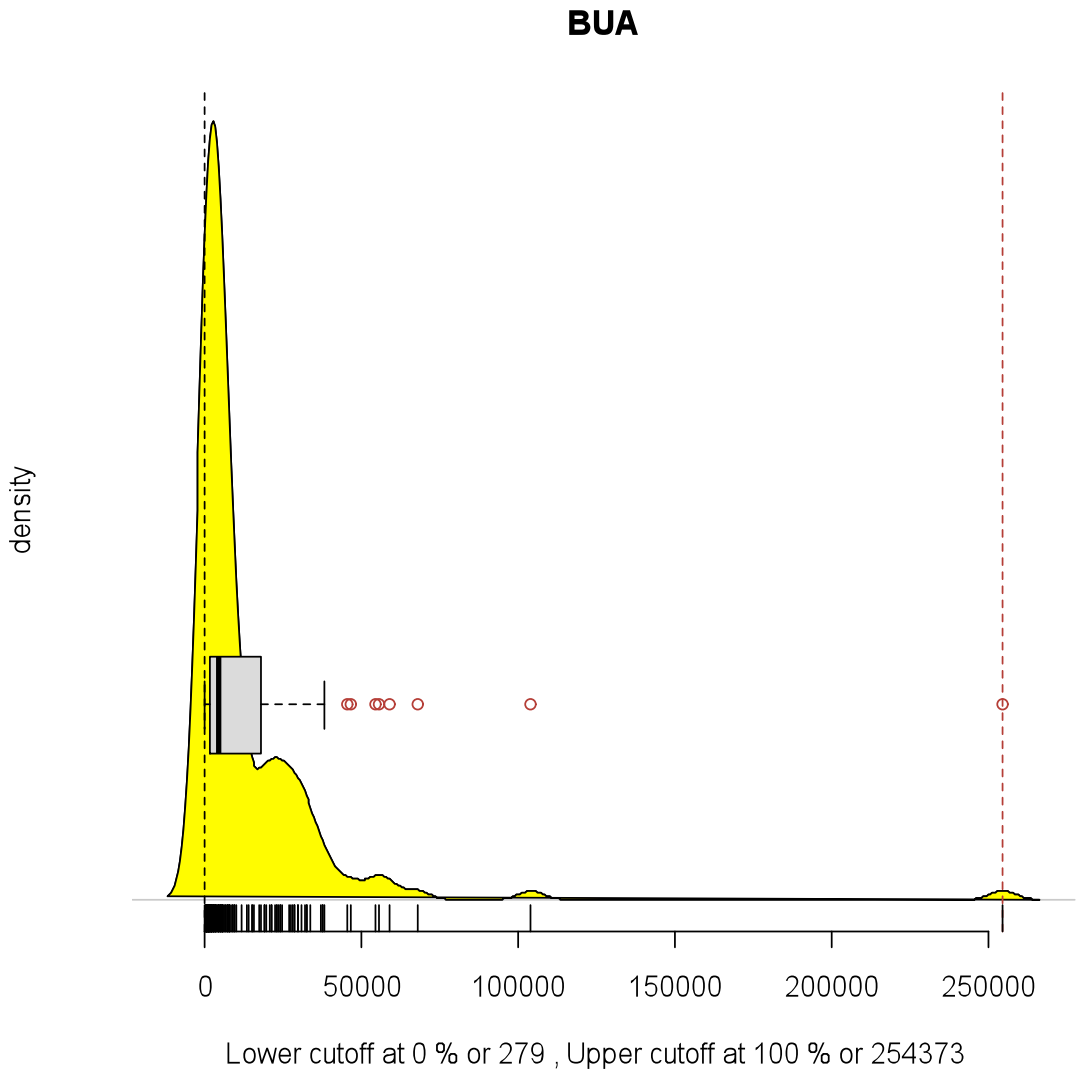


Figure 3-5

```
Original
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NA's
    279    1700    4500   13130   17780  254400       2
```

3.7. Space per bed

Original Density / Box plot	Data count
	152

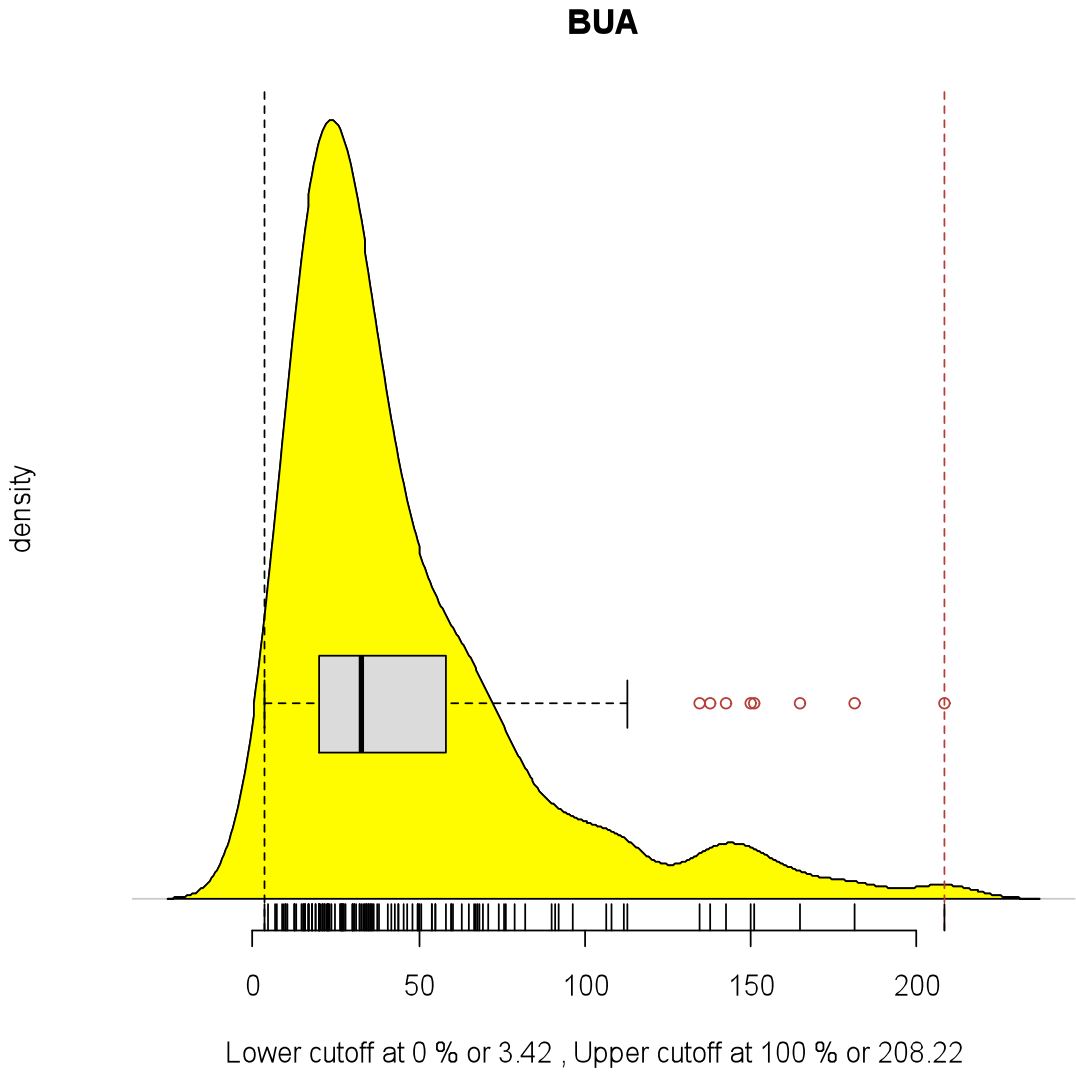


Figure 3-6

```
Original
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NA's
  3.425  20.100  32.660  45.480  58.210 208.200  23.000
```

3.8. Employees

Original Density / Box plot	Data count
	152

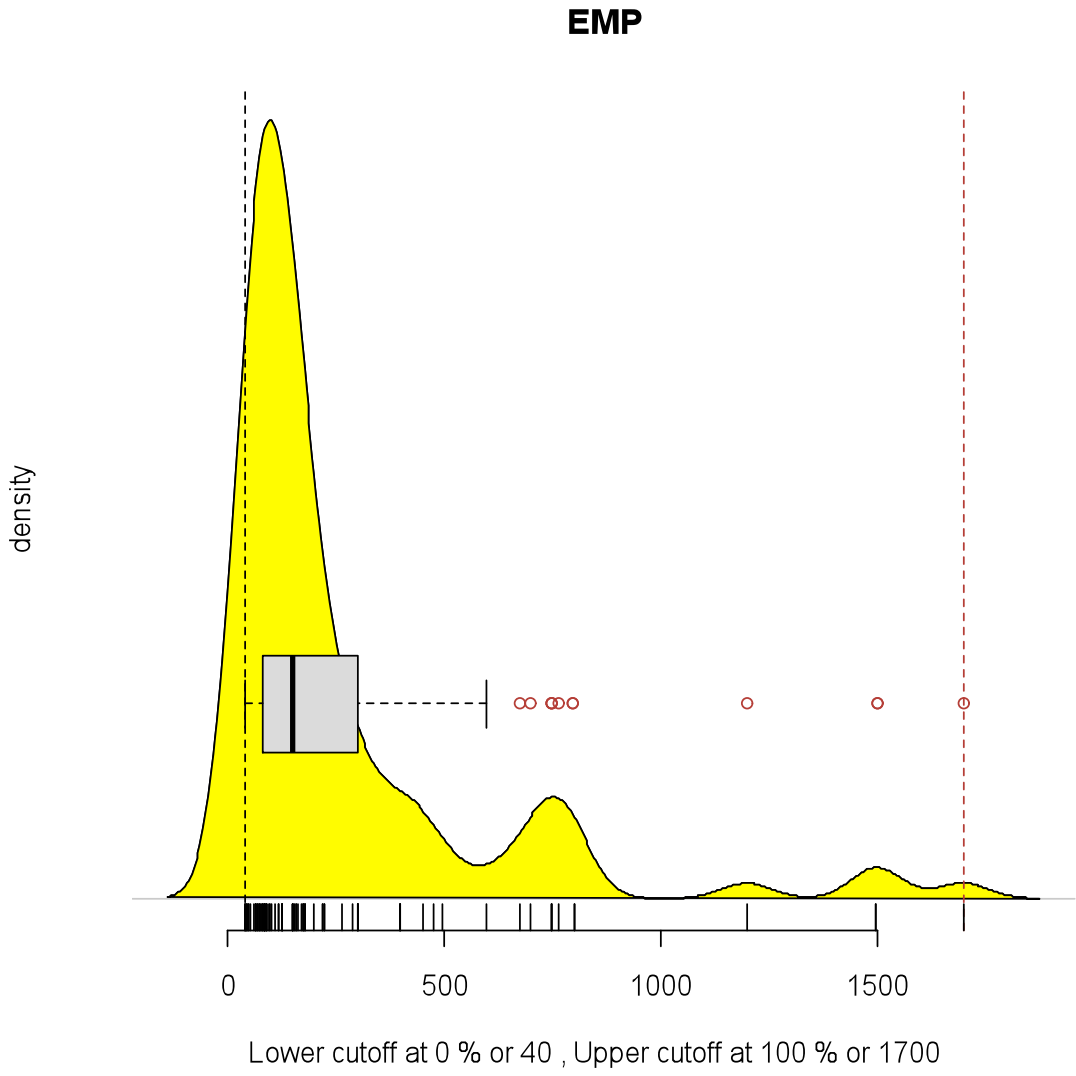


Figure 3-7

```
Original
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NA's
   40.0    81.0   150.0   266.1   300.0  1700.0    58.0
```

3.9. Employee per bed

Original Density / Box plot	Data count
	152

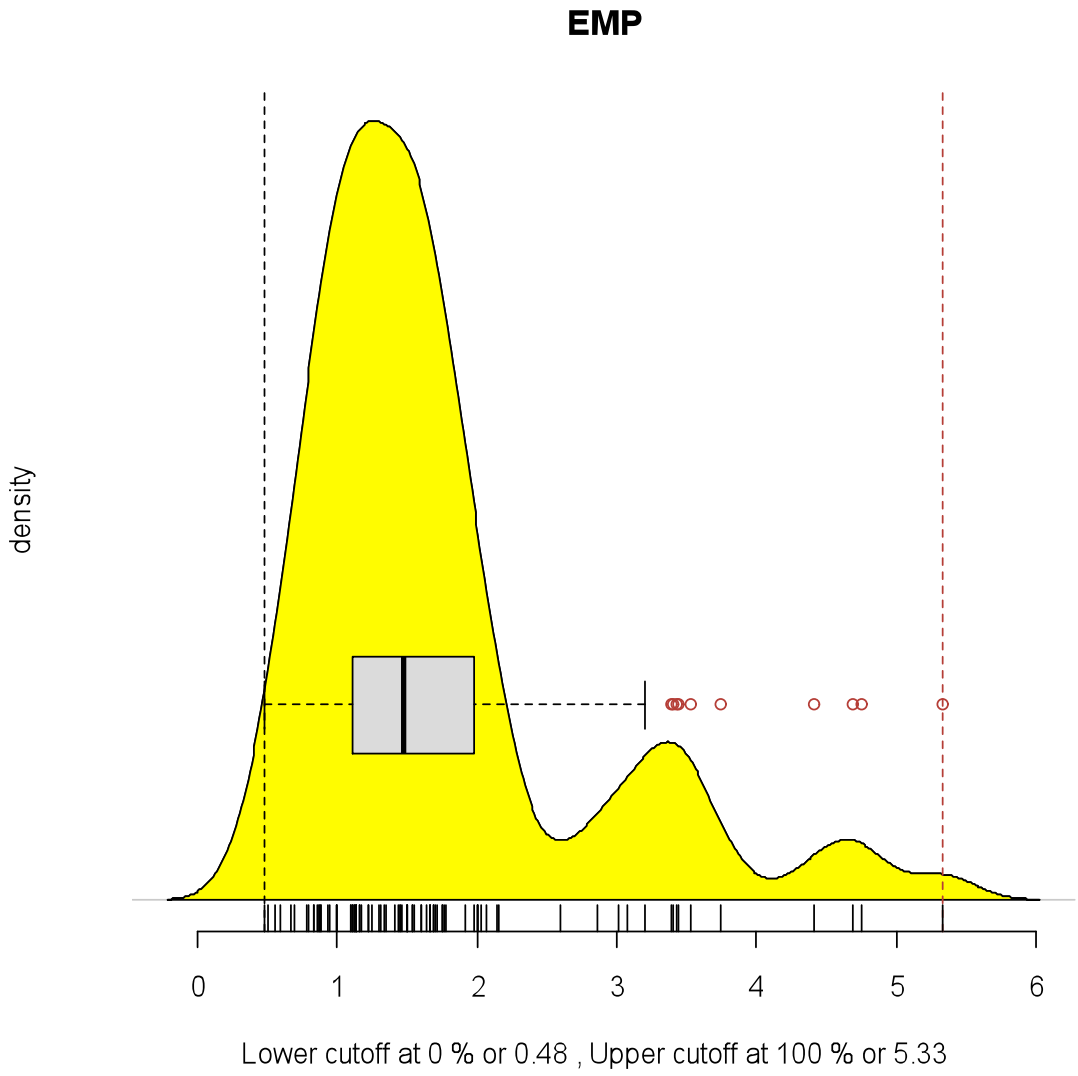
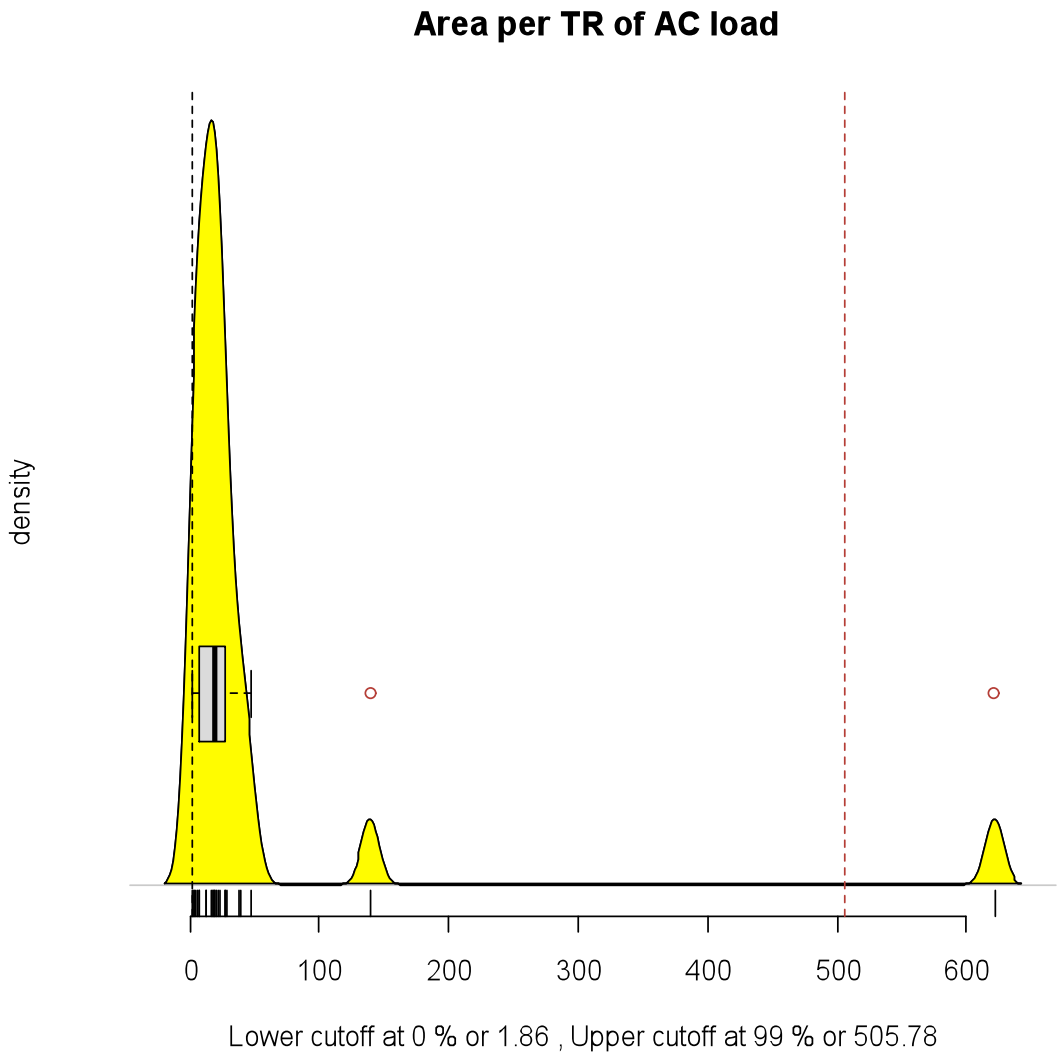


Figure 3-8

```
Original
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NA's
 0.4846  1.1110  1.4790  1.7160  1.9600  5.3330 62.0000
```

3.10.Area per TR of AC

Original Density / Box plot	Data count
	152



Observation: BID 150 has a very high area covered per TR of AC

Action: Tot.tr set to "NA"

Figure 3-9

```
Original
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NA's
```

```
  1.863   7.826  18.830  47.530  27.870 621.500 127.000
Modified
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NA's
  1.863   7.536  18.590  23.620  27.570 139.400 128.000
```

3.11.Number of Beds

Original Density / Box plot	Data count
	152

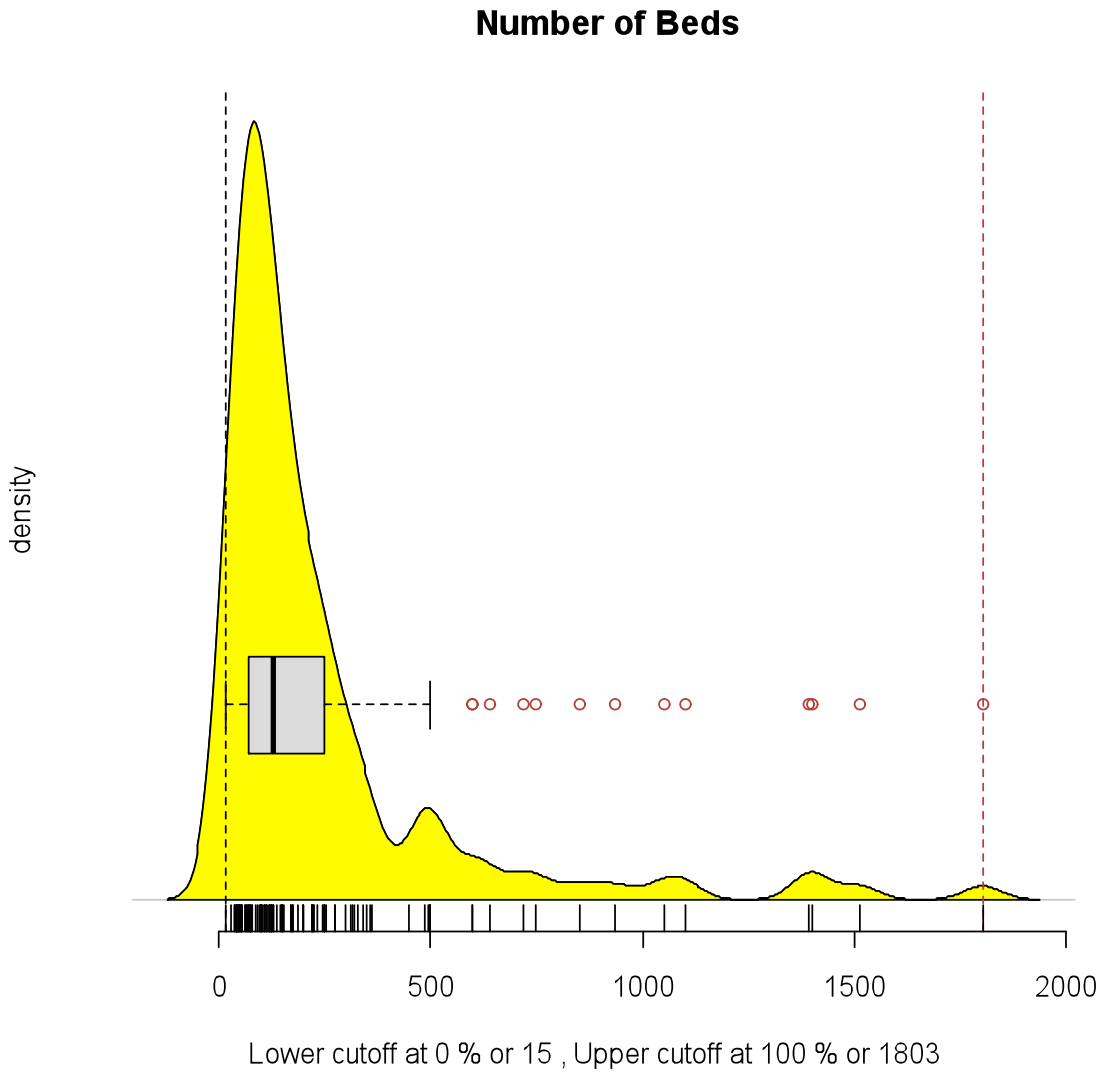


Figure 3-10

```
Original
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NA's
  15.00   71.25  130.00  244.30  250.00 1803.00   22.00
```

3.12.% Patient Overnight in a year

Original Density / Box plot	Data count
	152

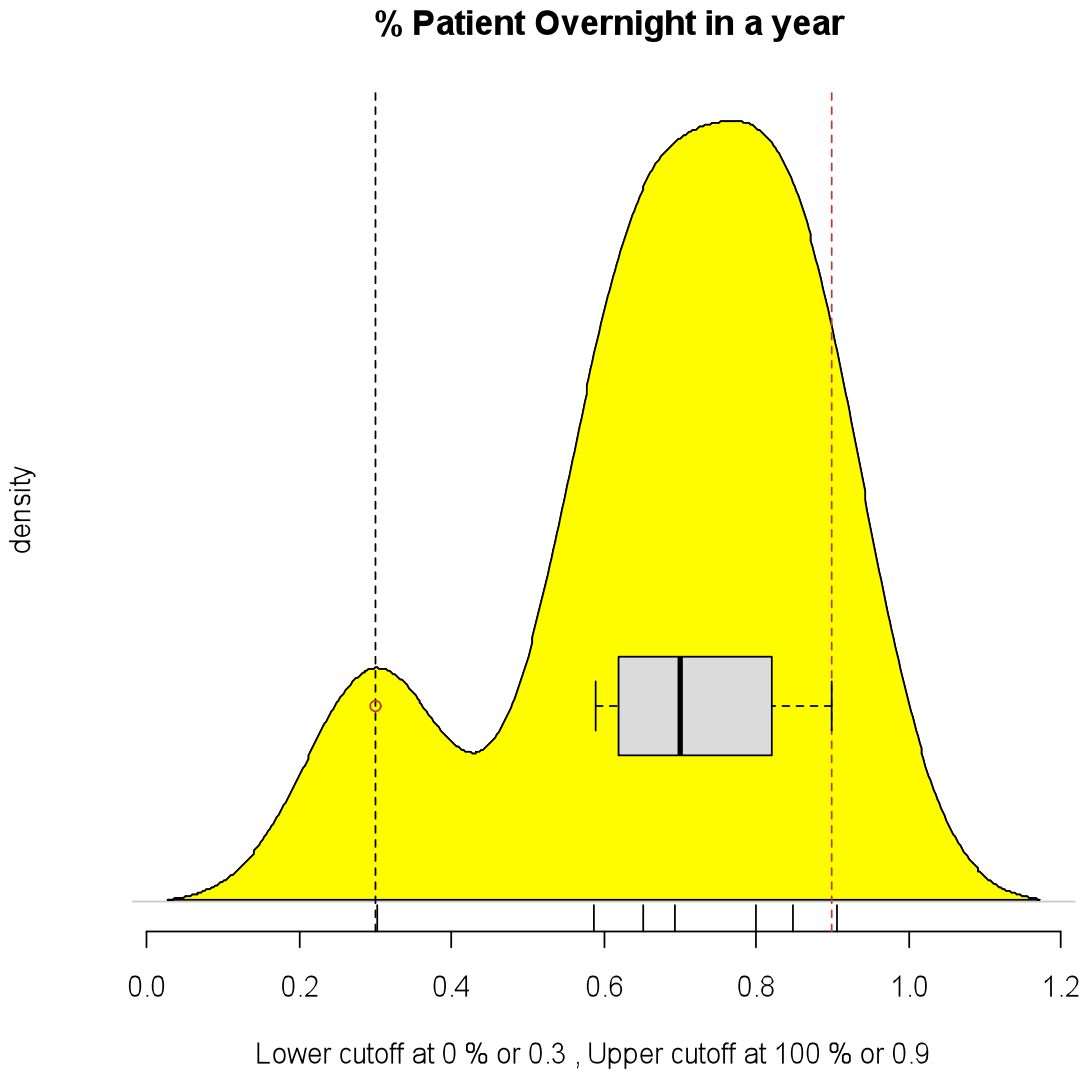


Figure 3-11

```
Original
    Min.  1st Qu.   Median     Mean  3rd Qu.     Max.     NA's
  0.3000   0.6200   0.7000   0.6829   0.8200   0.9000 145.0000
```

3.13.Daily Number of out-patients

Original Density / Box plot	Data count
	152

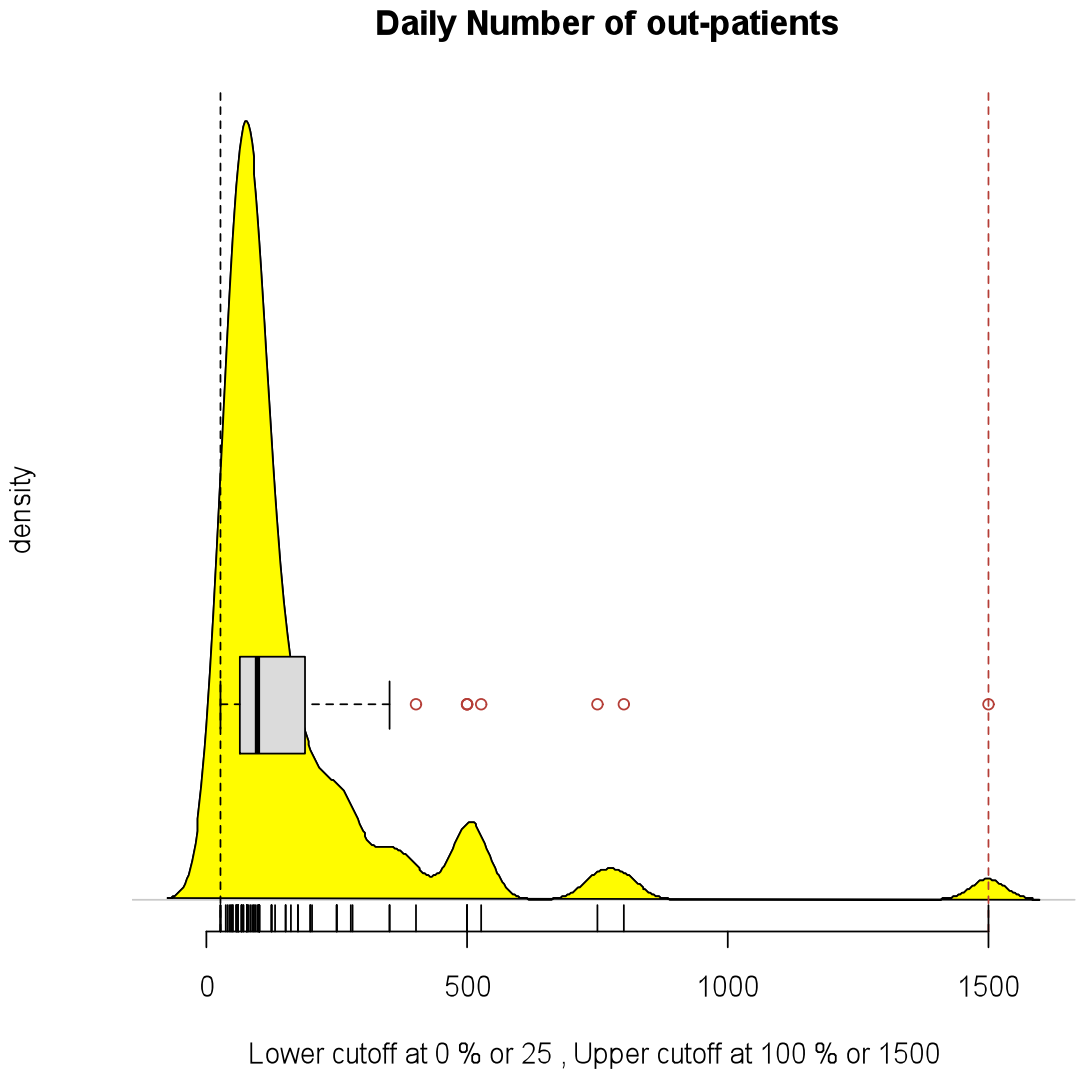


Figure 3-12

```
Original
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NA's
  25.00   63.75   97.50  174.20  181.20 1500.00   80.00
```

3.14.Final Summary

3.14.1. Summary

No. of observations = 152

	Var. name	obs.	mean	median	s.d.	min.	max.
3	epi	150	335.06	280.87	284.19	20.12	2609.76
5	epi.h	110	0.04	0.04	0.02	0.01	0.1
12	elec.pur	114	2202081.81	1465339	2233824.64	80000	7892000
13	elec.dg	111	68813.13	35444	111347.51	0	9e+05
14	kwh	152	2598585.2	1543651	2973560.38	9150	21283746
15	con.load	125	851.44	500	1533.67	100	13128.55
16	con.dem	25	1022.16	1000	650.73	200	2550
17	dg	18	1036.94	950	939.7	65	3000
18	elec.pur.cost	113	12755787.65	7262280	16760249.28	581380	9e+07
19	elec.dg.cost	110	607895.58	284116	955911.84	7130	7200000
20	elec.cost	134	14000317.05	7519937	21000226.79	78271	167184586
21	bua	150	13128.68	4500	25237.71	279	254373
22	car.con	29	11508.17	7993	12724.5	162	50875
23	floors	18	6.78	6.5	3.51	2	12
24	pac2	28	0.52	0.6	0.33	0.01	1
26	empden	93	0.05	0.05	0.04	0.01	0.17
31	hrs	112	8625.92	8760	824.77	3128.57	8760
32	hrs.day	116	23.56	24	2.27	10	24
33	days.week	112	6.96	7	0.31	4	7
34	shifts	116	2.974	3	0.159	2	3
35	emp	94	266.1	150	327.18	40	1700
40	nbeds	130	244.29	130	309.9	15	1803
41	opd.day	72	174.21	97.5	225.13	25	1500
42	ppatients	7	0.68	0.7	0.2	0.3	0.9
43	tot.tr	48	401.23	321	352.86	9	1660
44	ar.tr	24	23.62	18.59	27.5	1.86	139.41
45	bua.emp	93	28.23	20.57	22.73	5.88	125
46	bua.bed	129	45.48	32.66	38.51	3.42	208.22
47	emp.bed	90	1.72	1.48	1	0.48	5.33

Table 3-2:

3.14.2. Subtype

General Hospital	Multi Specialty	Secondary Govt
14	129	9

Table 3-3:

3.14.3. Climatic Zones and Conditioning status

No. of observations	Conditioned	Unconditioned	NA	Total
Cold	0	0	20	20
Composite	6	6	35	47
Hot & Dry	1	0	25	26
Temperate	4	0	21	25
Warm & Humid	7	4	23	34
Total	18	10	124	152

Table 3-4:

3.14.4. Ownership

No. of observations	Conditioned	Unconditioned	NA	Total
Private	18	7	116	141
Public	0	3	8	11
Total	18	10	124	152

Table 3-5:

3.14.5. Shifts

1 shift	2 shifts	3 shifts	<NA>
0	3	113	36

Table 3-6:

3.14.6. Assumptions:

Since % conditioned space information is not available for majority of Hospitals, it is assumed that all Multi Specialty Hospitals are conditioned. Further, it is assumed that the Multi Specialty Hospitals operate in all 3 shifts.

3.14.7. Climatic Zones and Conditioning status (revised)

No. of observations	Conditioned	Unconditioned	NA	Total
Cold	20	0	0	20
Composite	38	3	6	47
Hot & Dry	22	0	4	26
Temperate	25	0	0	25
Warm & Humid	28	3	3	34
Total	133	6	13	152

Table 3-7:

3.14.8. Ownership (revised)

No. of observations	Conditioned	Unconditioned	NA	Total
Private	132	3	6	141
Public	1	3	7	11
Total	133	6	13	152

Table 3-8:

No. of observations	Multi Specialty	Others	Total
Private	128	13	141
Public	1	10	11
Total	129	23	152

Table 3-9:

No. of observations	Conditioned	Unconditioned	NA	Total
Multi Specialty	129	0	0	129
Others	4	6	13	23
Total	133	6	13	152

Table 3-10:

3.14.9. Shifts (revised)

1 shift	2 shifts	3 shifts	<NA>
0	2	132	18

Table 3-11:

All except one Multi Specialty hospitals are privately owned

3.15.General Profile of Hospitals in the Sample

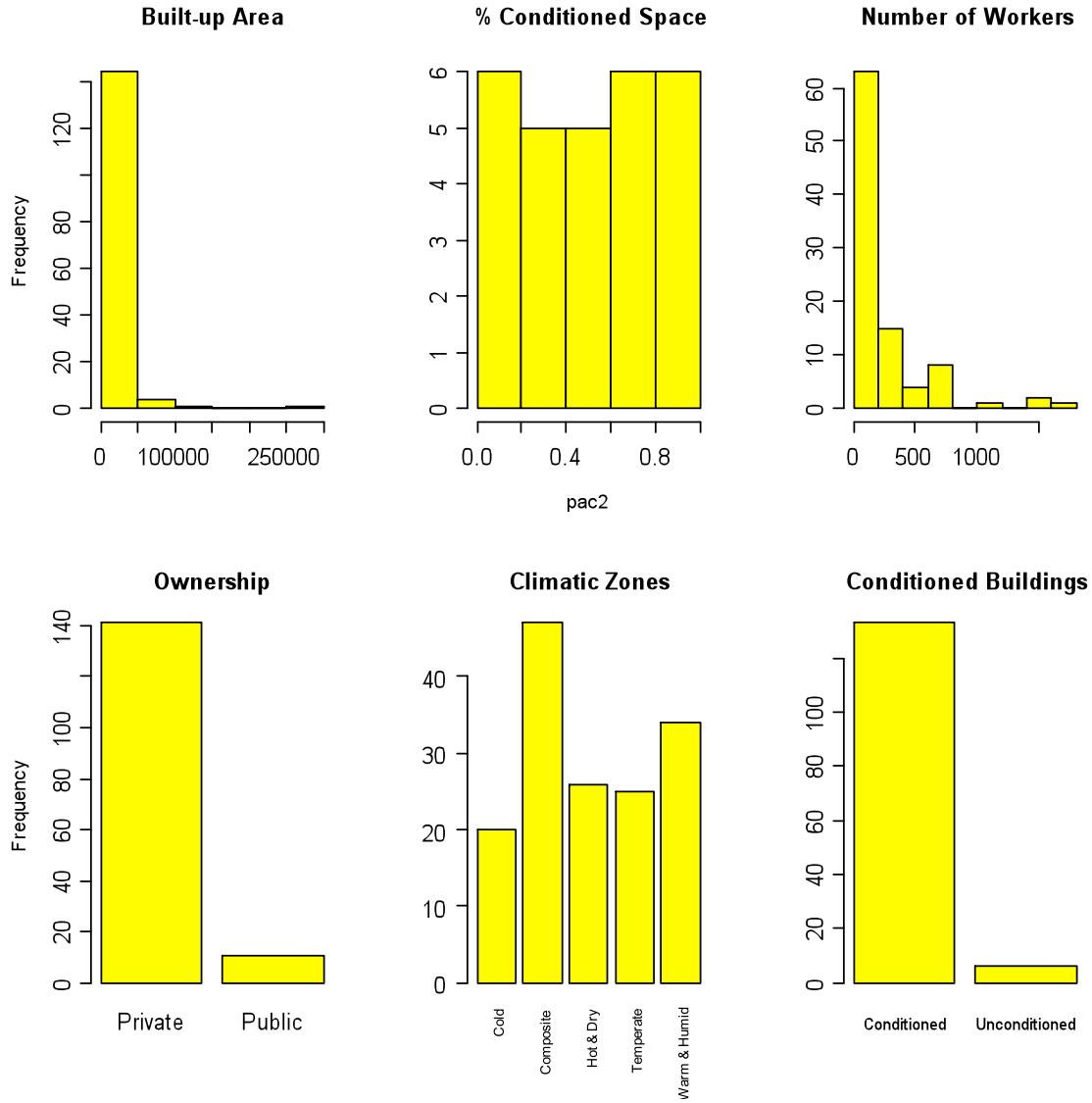


Figure 3-13

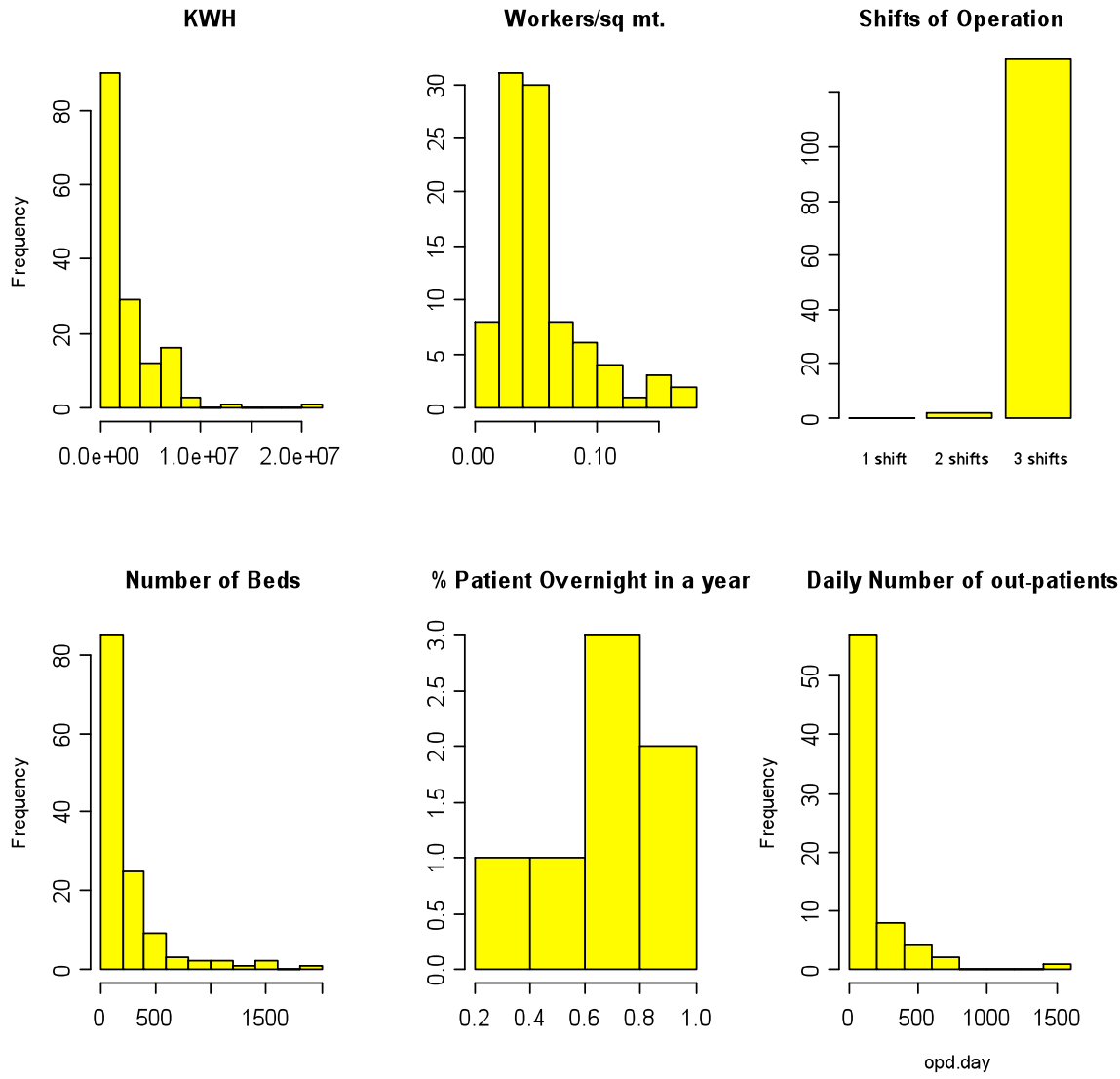

KWH
Frequency
0
20
40
60
80
0.0e+00
1.0e+07
2.0e+07
Workers/sq mt.
0
5
10
15
20
25
30
0.00
0.10
Shifts of Operation
0
20
40
60
80
100
1 shift
2 shifts
3 shifts
Number of Beds
Frequency
0
20
40
60
80
0
500
1500
% Patient Overnight in a year
0.0
0.5
1.0
1.5
2.0
2.5
3.0
0.2
0.4
0.6
0.8
1.0
Daily Number of out-patients
Frequency
0
10
20
30
40
50
0
500
1000
1500
opd.day

Figure 3-14

3.16.EPI

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	NA's
20.12	197.80	280.90	335.10	385.80	2610.00	2.00

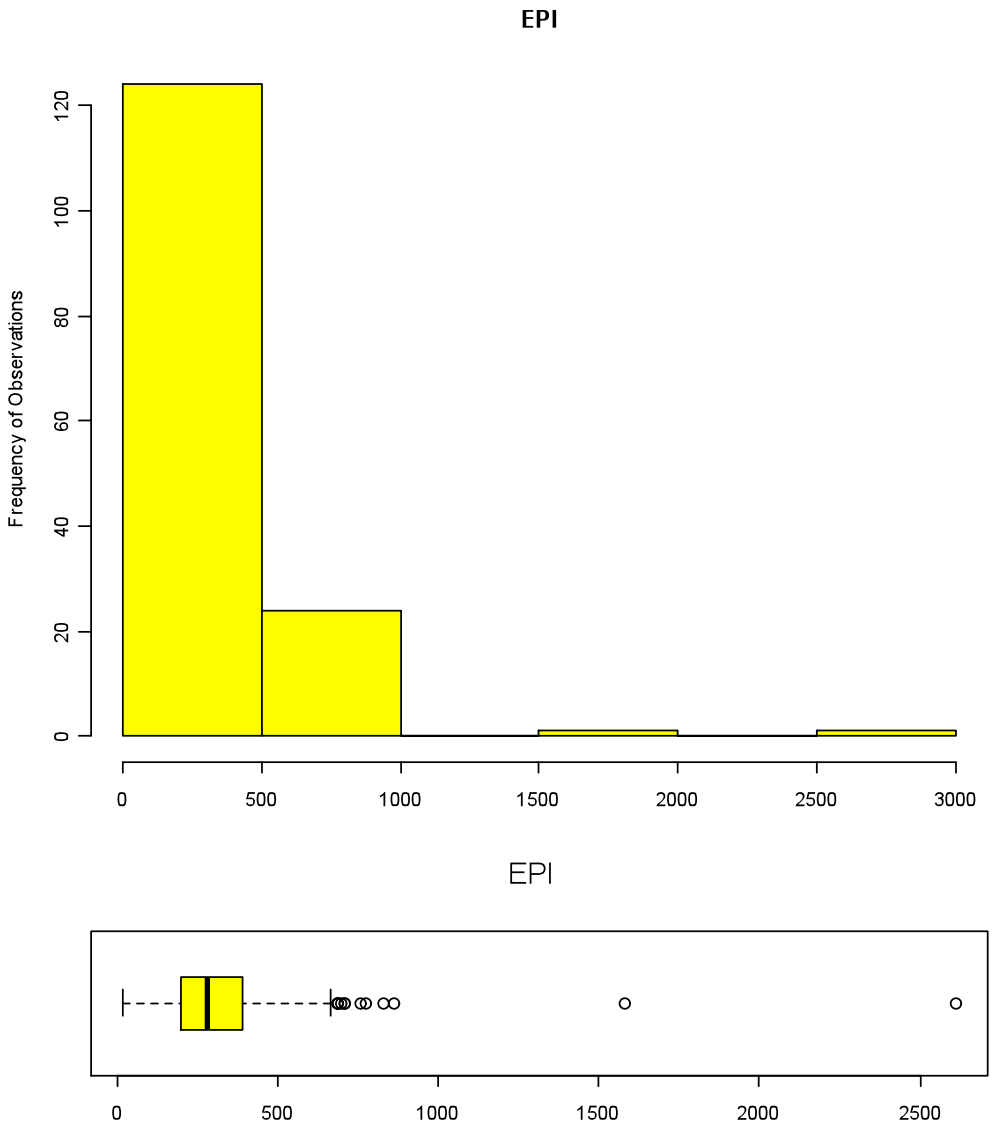


Figure 3-15

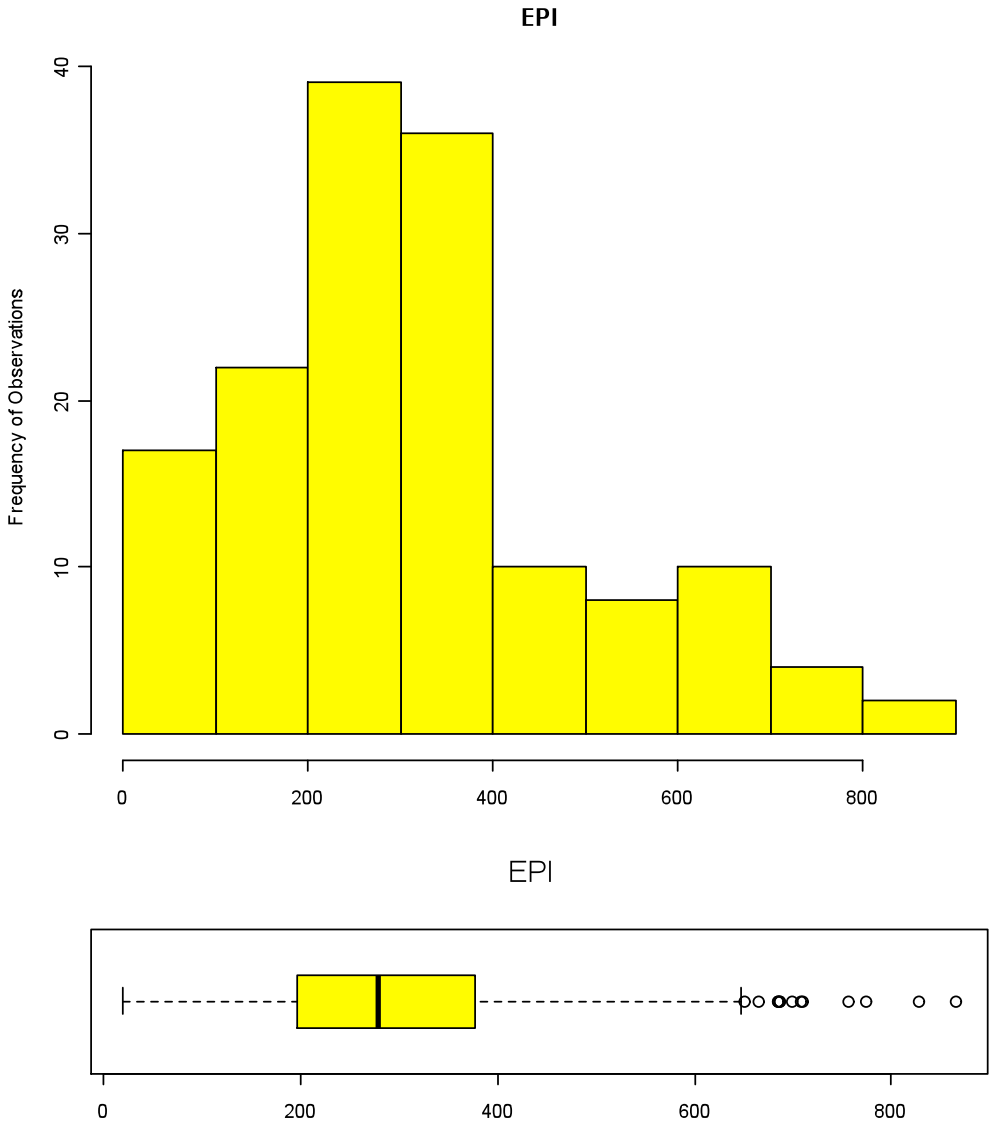
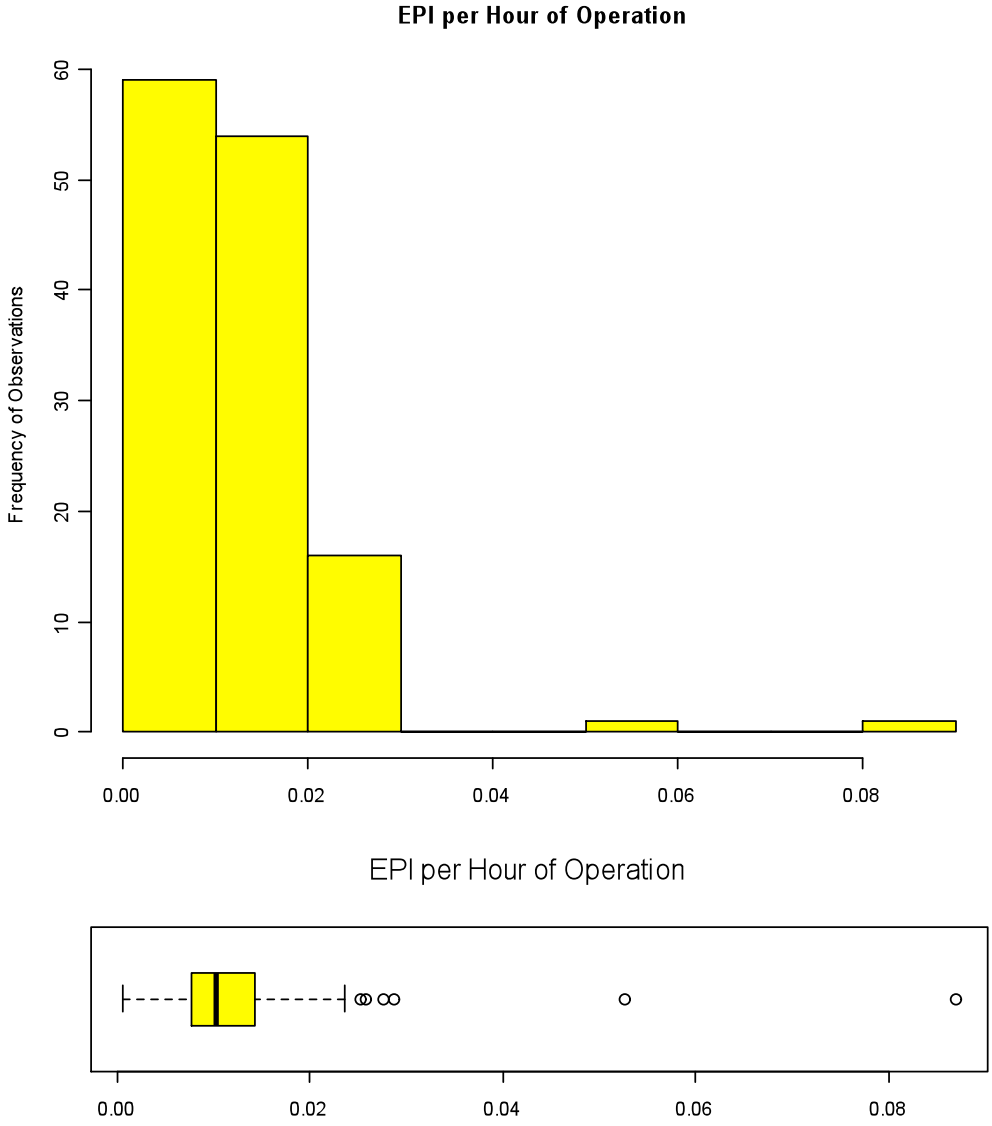


Figure 3-16: EPI

Note: X-axis is trimmed in above graph for presentation purpose only

3.16.1. EPI per Hour of Operation

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	NA's
0.000677	0.007646	0.010210	0.012510	0.014290	0.086890	21.000000



Note: This statistic is not as critical to Hospitals as to Office as most of the hospitals are operating in 3 shifts

3.16.2. Ownership and EPI

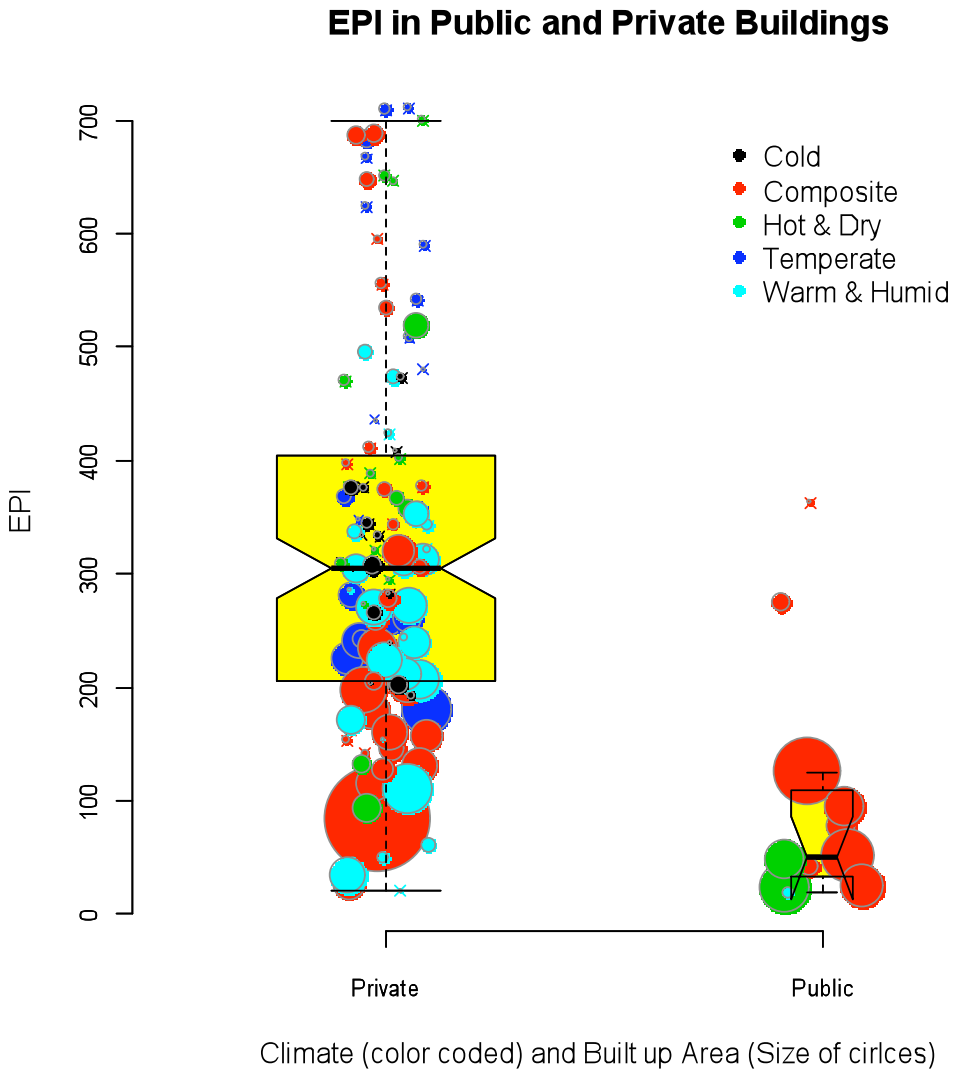


Figure 3-17

Note: Y-axis is trimmed for representation purpose

EPI	count	mean	median	sd	min	max
1 Cond	132	370.48	305.78	283.8	20.33	2609.8
2 Uncond	6	52.65	46.87	37.6	20.12	125.2
3 Pvt	139	353.38	304.61	285.8	20.33	2609.8
4 Pub	11	103.54	50.01	112.8	20.12	362.6

EPI	count	mean	median	sd	min	max

1	Cond	Pvt	131	371.22	306.24	284.75	20.33	2609.76
2	Uncond	Pvt	3	40.19	45.42	11.66	26.83	48.32
3	Cond	Pub	1	274.22	274.22	NA	274.22	274.22
4	Uncond	Pub	3	65.11	50.01	54.15	20.12	125.21

Table 3-12:

3.16.3. EPI for Hospital Types

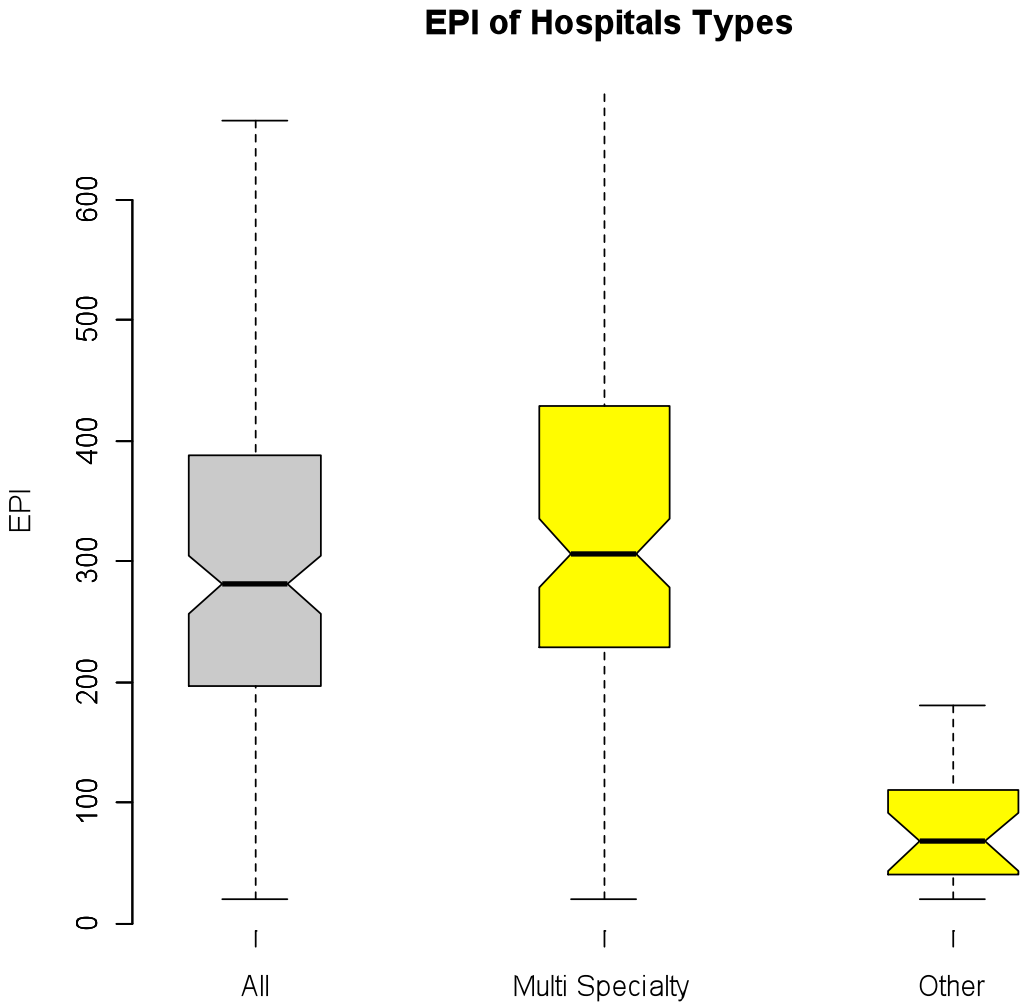


Figure 3-18

EPI of Hospital Types

	obs.	mean	median	s.d.	min.	max.
All	150	335.063	280.871	284.19	20.12	2609.756
Multi Specialty	128	377.479	307.044	285.35	20.333	2609.756
Others	22	88.278	67.493	76.59	20.12	362.578

Table 3-13:

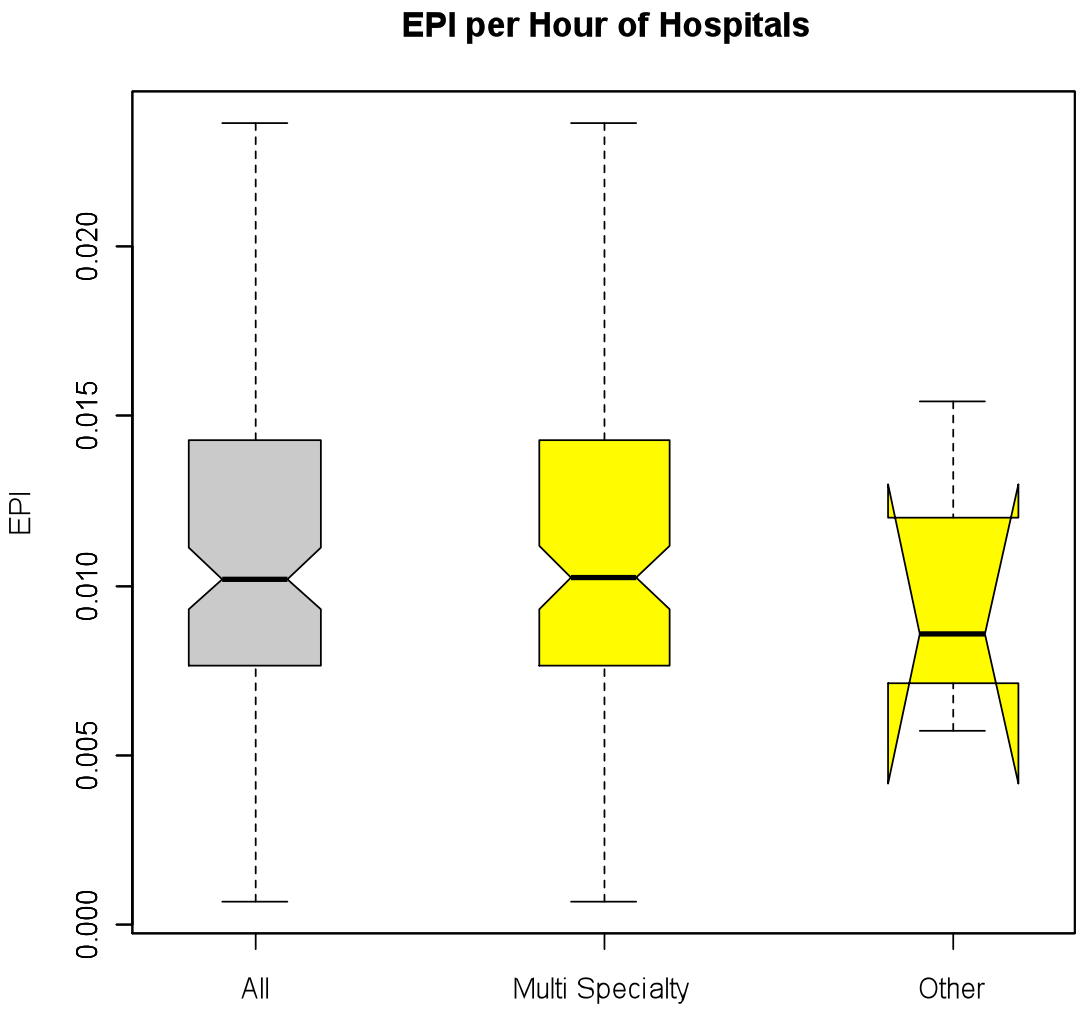


Figure 3-19

Note: Hours of operation data is available for only 3 non multi specialty hospital

Note that the EPI of non Multi Specialty hospitals may not be very low compared to Multi Specialty hospitals as the former may not be operating in all 3 shifts. However, the hours of operation data are not available for most of them and hence normalization is difficult. The three non multispecialty hospitals for which hours of operation data is available reveals that their median EPI is quite comparable to multi specialty hospitals.

3.16.4. Climate and EPI

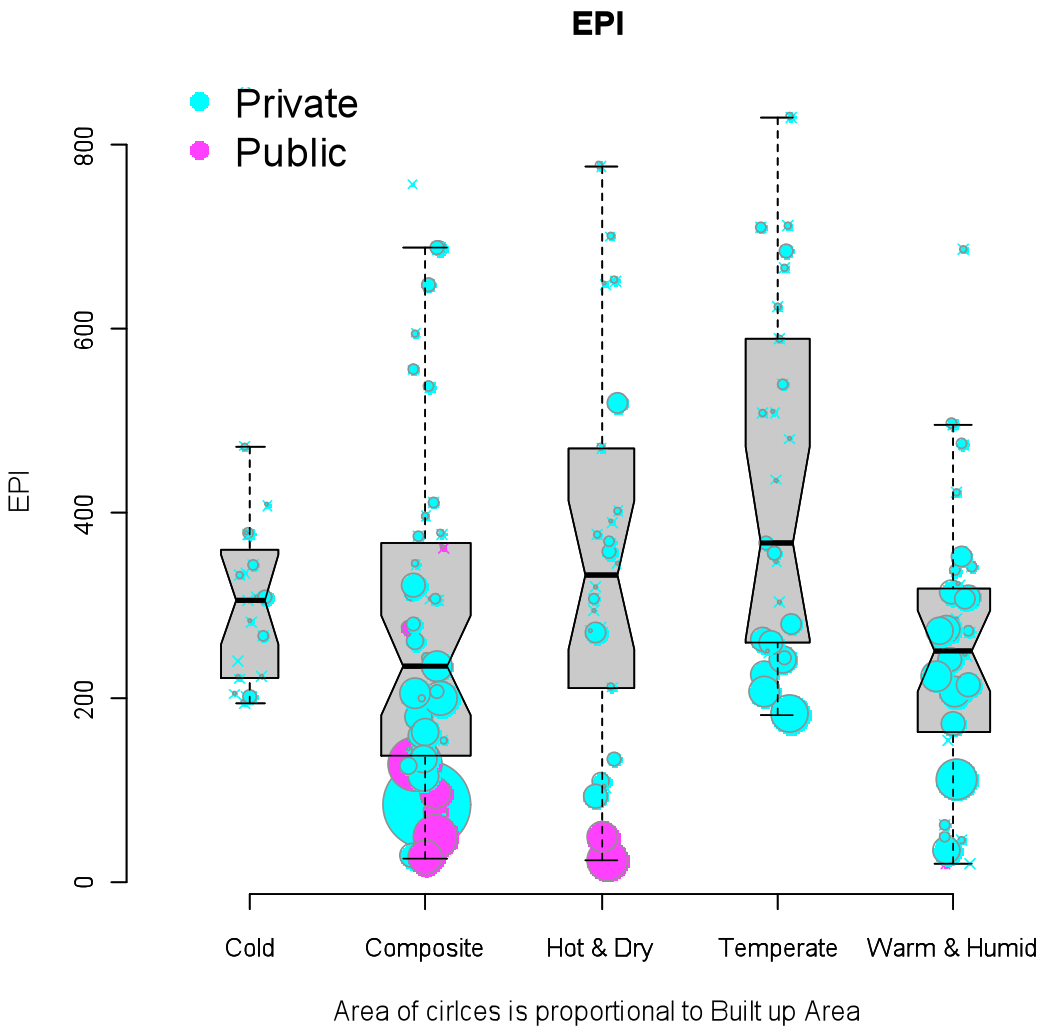


Figure 3-20

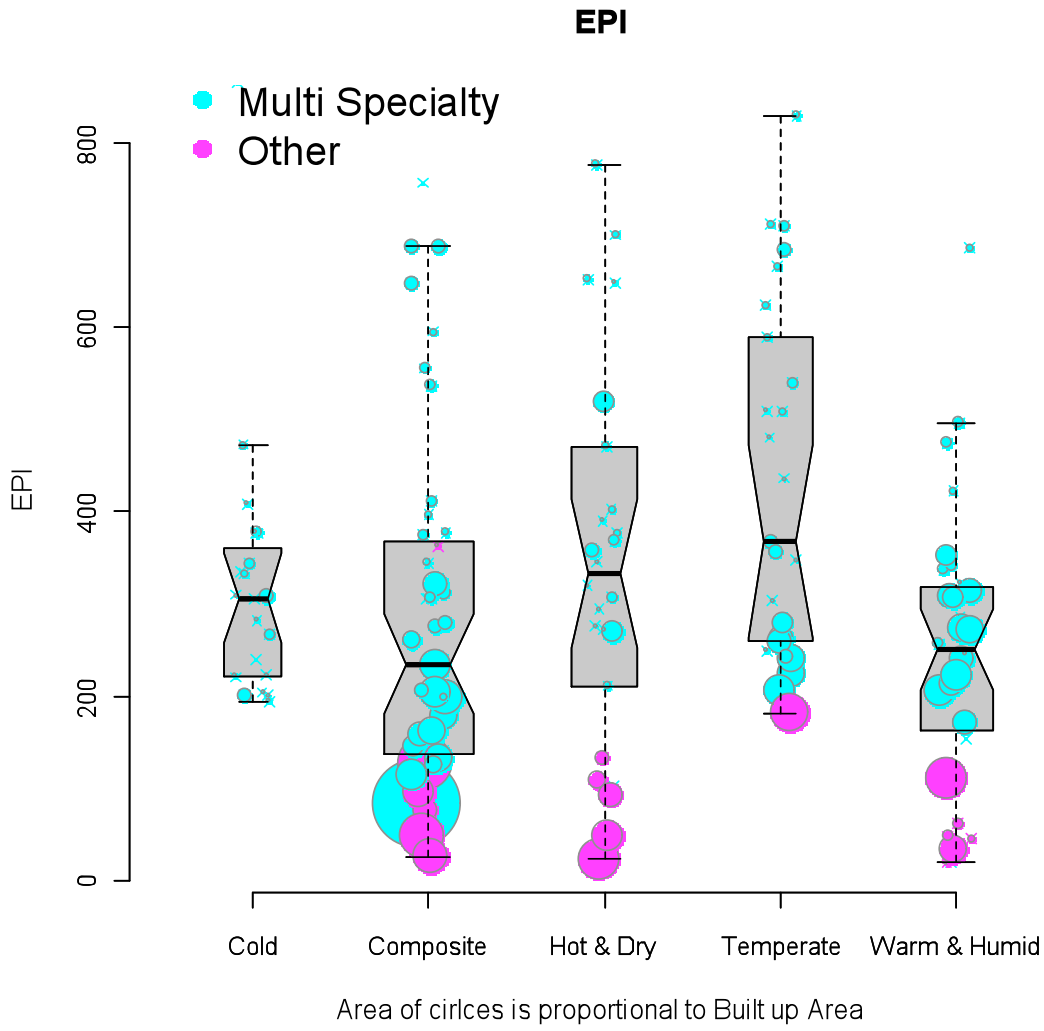


Figure 3-21

Small private multi specialty hospitals have large EPI

Public Hospitals have small EPI

EPI	count.epi	mean.epi	median.epi	sd.epi	min.epi	max.epi
1 Cold	20	323.1	305.9	149.3	193.33	865.0
2 Composite	47	1320.1	234.8	389.5	24.74	2609.8
3 Hot & Dry	26	1386.0	332.8	315.4	23.02	1581.0
4 Temperate	25	1432.1	366.7	193.2	180.60	828.6
5 Warm & Humid	32	247.3	250.5	148.9	20.12	685.5

EPI		count.epi	mean.epi	median.epi	sd.epi	min.epi	max.epi
Cold	MS	20	323.14	305.92	149.27	193.33	865.0
Composite	MS	37	378.62	277.49	418.04	83.67	2609.8
Hot & Dry	MS	21	458.57	366.73	308.41	102.06	1581.0
Temperate	MS	24	442.59	401.34	189.98	207.35	828.6
Warm & Humid	MS	26	292.06	271.76	127.27	20.33	685.5
Cold							
Composite	Oth	10	103.63	75.29	100.87	24.74	362.6
Hot & Dry	Oth	5	81.02	93.30	45.08	23.02	133.1
Temperate	Oth	1	180.60	180.60	NA	180.60	180.6
Warm & Humid	Oth	6	53.35	46.87	31.64	20.12	111.2

MS: Multi Specialty, Oth: Others

Table 3-14:

3.16.5. Summary of EPI

Median EPI

		# obs	All	Cold	Composite	Hot & Dry	Temperate	Warm & Humid
All	All	150	281	306	235	333	367	250
	Public	11	50	NA	86	35	NA	20
	Private	139	305	306	259	351	367	256
	Multi Specialty	128	307	306	277	367	401	272
	Other	22	67	NA	75	93	181	47

Table 3-15:

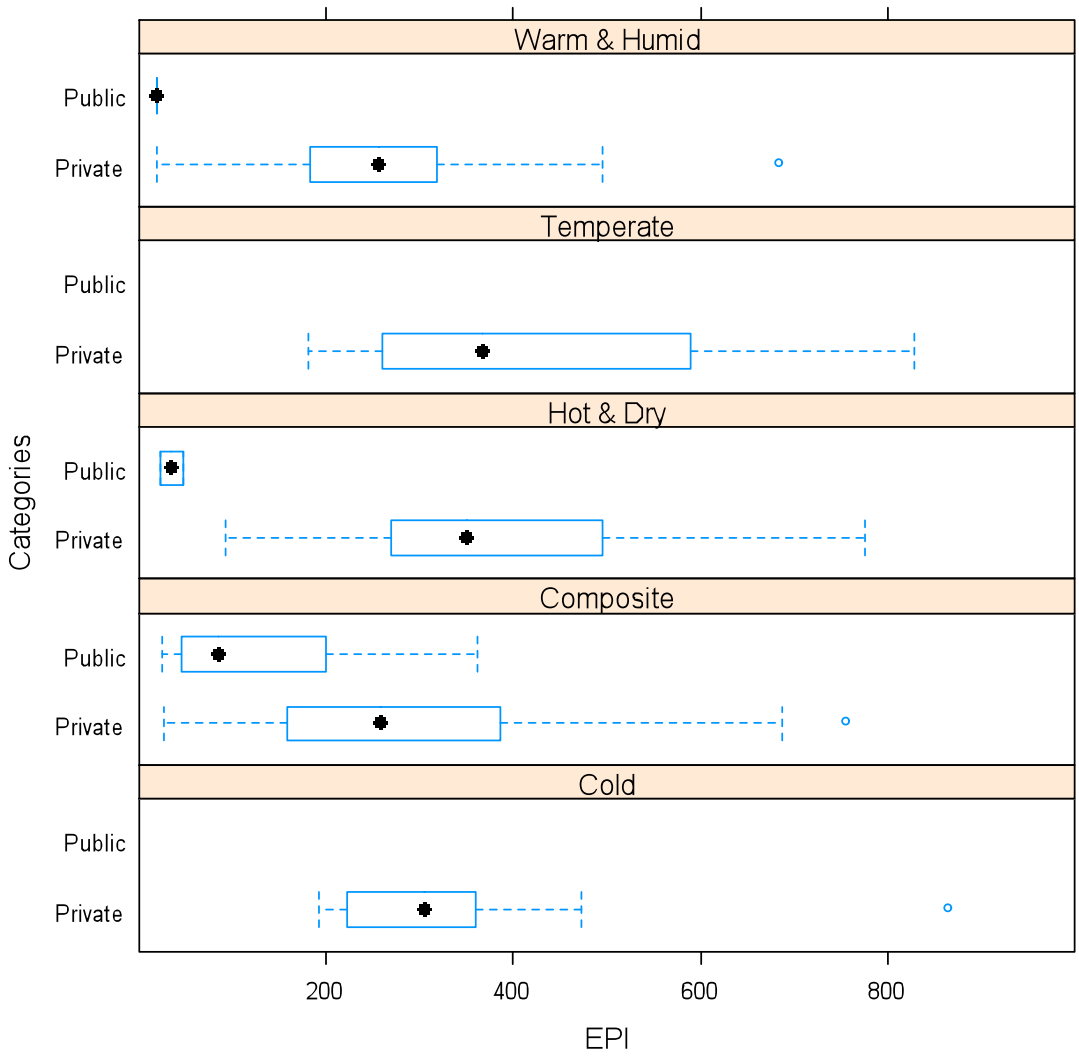

Warm & Humid
Temperate
Hot & Dry
Composite
Cold
Public
Private
Categories
200
400
600
800
EPI

Figure 3-22

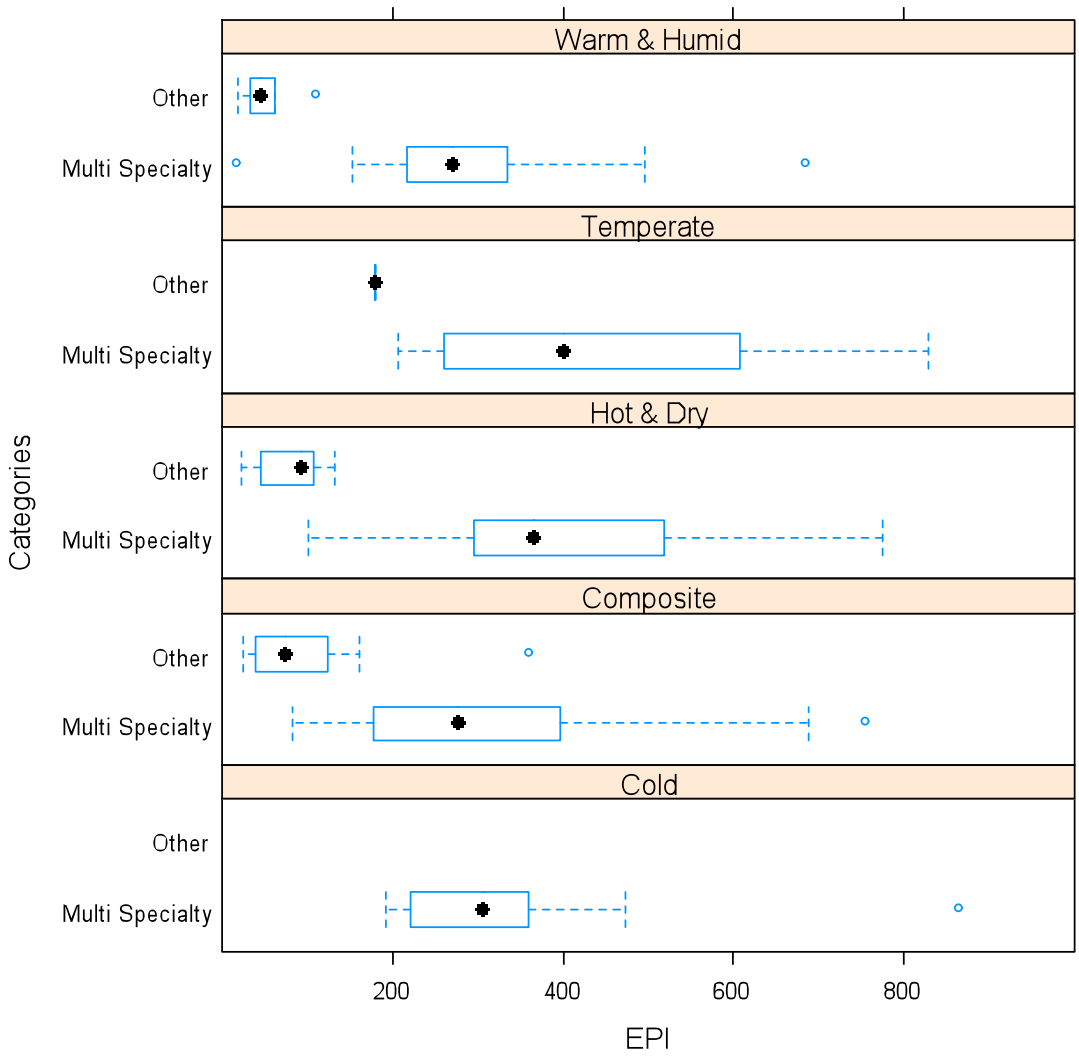

Warm & Humid
Temperate
Hot & Dry
Composite
Cold
Other
Multi Specialty
Categories
200
400
600
800
EPI

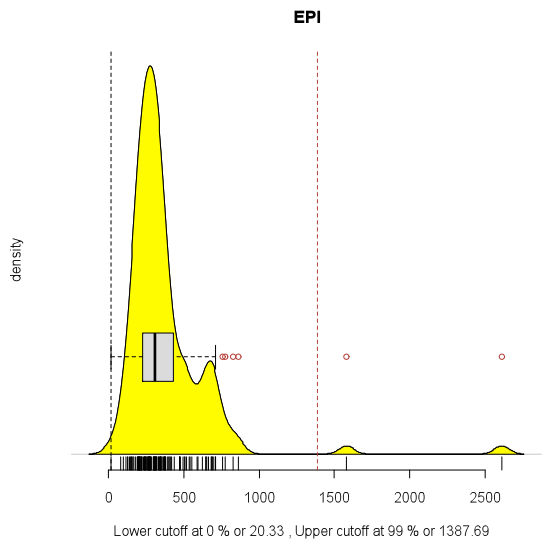
Figure 3-23

3.17.Multi Specialty Hospitals

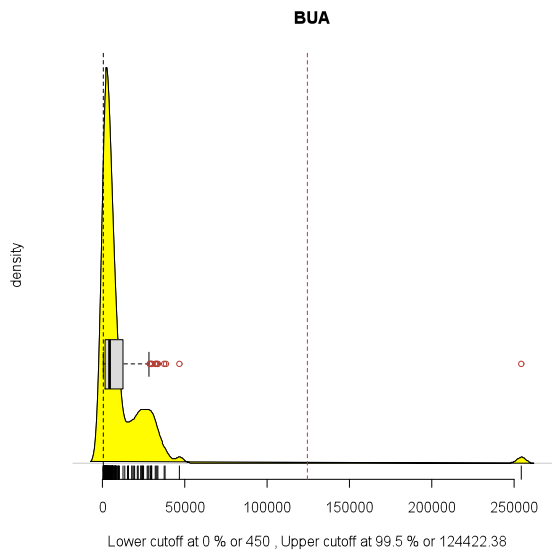
From this point onwards, the document focuses on Multi specialty Hospitals only

3.17.1. Trimming

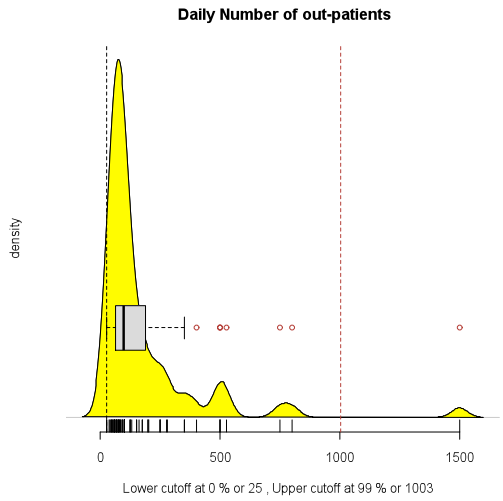
The aim of this section is to create a homogenous sample set which will help us draw inference with a higher level of confidence.



EPI, BID dropped: 139 144



BUA, BID dropped: 161



OPD, BID dropped: 729

Figure 3-24

3.17.2. General characteristics of sample

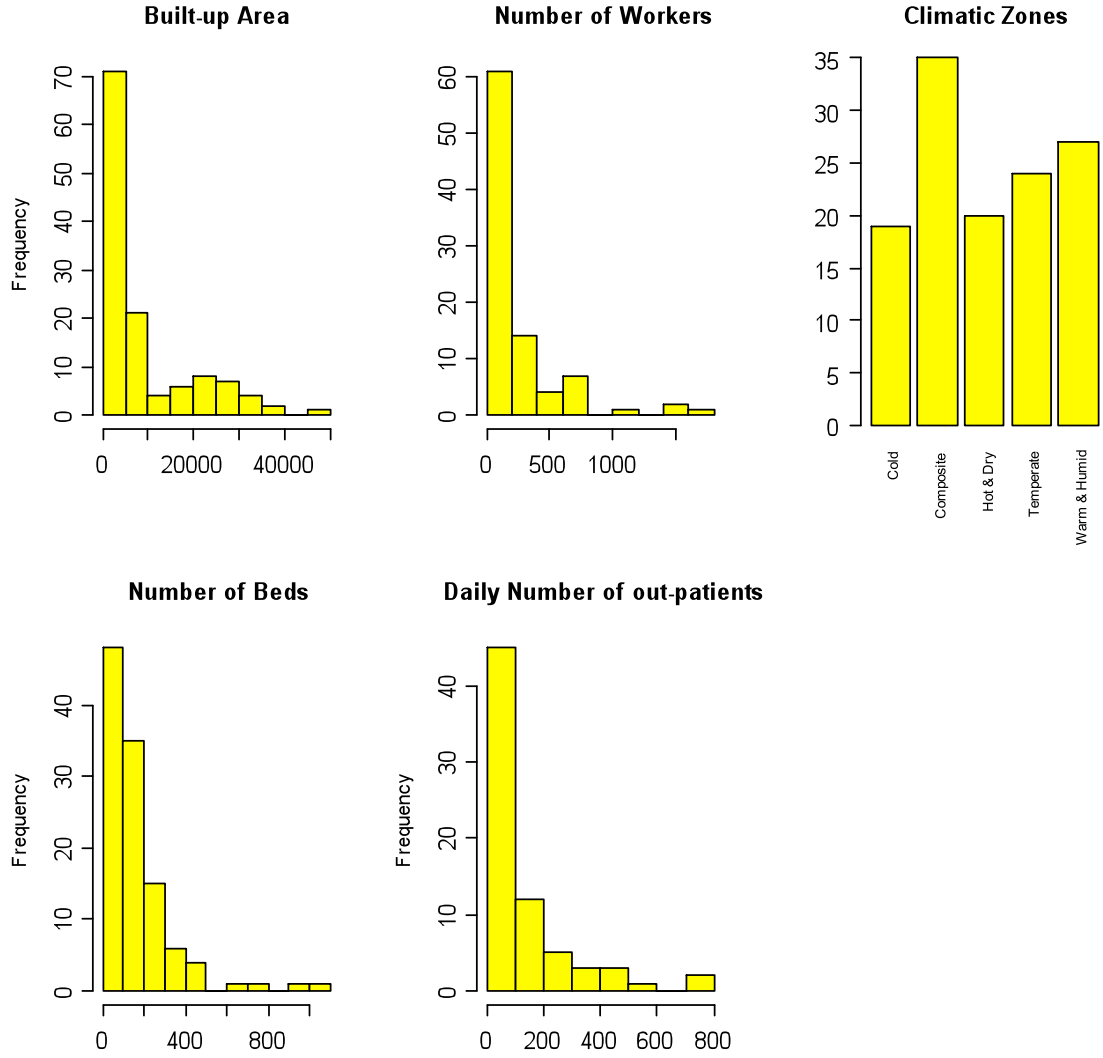


Figure 3-25

No. of observations = 125

	Var. name	obs.	mean	median	s.d.	min.	max.
3	epi	124	353.56	307.04	173.93	20.33	864.97
12	elec.pur	109	2249958.32	1478222	2259281.6	80000	7892000
13	elec.dg	106	70785.16	35629.5	113405.73	0	9e+05
14	kwh	125	2481011.01	1664981	2377100.49	9150	9166000
15	con.load	112	653.42	442	628.48	100	2553
16	con.dem	21	1016.86	1000	604.53	200	2550
17	dg	12	1481.25	1132.5	846.93	450	3000
18	elec.pur.cost	108	13097936.01	7445555	17026851.9	581380	9e+07
19	elec.dg.cost	105	621146.51	285392	971368.88	12000	7200000
20	elec.cost	116	13912920	8007802.5	17089122.93	78271	90200000
21	bua	124	8845.88	4150	10551.72	450	46452
22	car.con	17	10847.41	10223	9957.71	180	30478
23	floors	12	6.83	6.5	3.66	2	12
26	empden	90	0.05	0.05	0.04	0.01	0.17
35	emp	90	264.42	137.5	330.85	40	1700
40	nbeds	112	168.47	120	172.25	15	1100
41	opd.day	71	155.54	95	161.07	25	800
42	ppatients	6	0.75	0.75	0.12	0.59	0.9
43	tot.tr	28	488.11	464	371.88	23	1660
44	ar.tr	15	17.89	18.36	11.35	3.15	39.83
45	bua.emp	90	27.88	20.55	22.5	5.88	125
46	bua.bed	111	42.81	32.35	32.69	4.58	164.92
47	emp.bed	89	1.72	1.5	1.01	0.48	5.33

Table 3-16:

3.17.3. Subgroups

The sample contains Multi Specialty hospital which varies from very small to very big in size and operation. It is possible to create two sub groups in terms of built-up area (<>5,000) or number of number of beds (<>100). From the graph below, it seems logical to define the groups based on built up area.

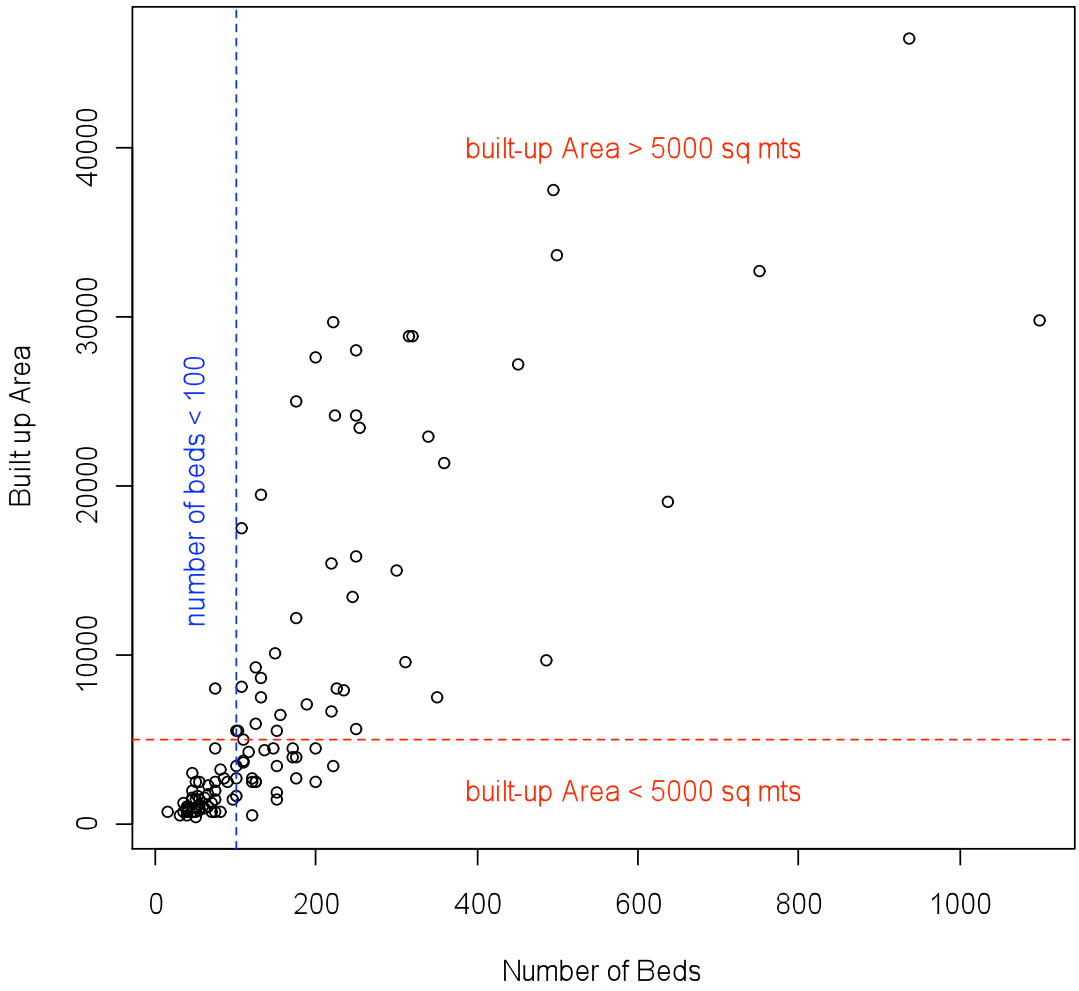


Figure 3-26

Small Hospitals: BUA < 5000 sq mts

Large Hospitals: BUA >=5000 sq mts

3.17.4. General characteristics of sub-sample

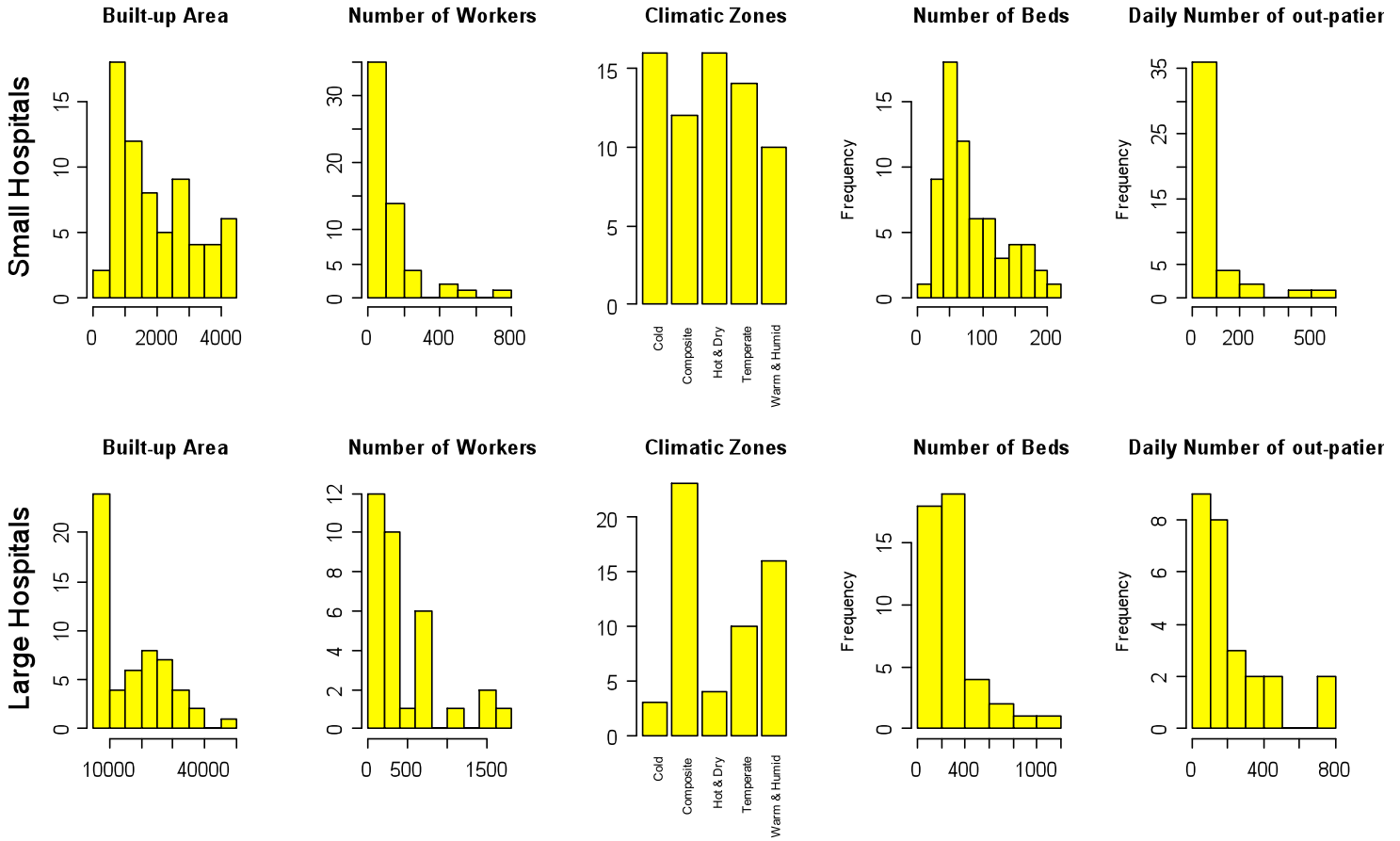


Figure 3-27

Small Hospitals

No. of observations = 69

Var. name	obs.	mean	median	s.d.	min.	max.
epi	68	393.77	344.26	190.18	20.33	864.97
elec.pur	64	865261.08	596987.5	744424.46	80000	2745875
elec.dg	63	45083.06	32000	56833.85	500	381200
kwh	68	874219.13	546463	746708.18	9150	2805875
con.load	64	275.28	200	190.89	100	925
con.dem	4	318.75	287.5	128.09	200	500
dg	1	450	450	<NA>	450	450
elec.pur.cost	64	4334777.83	3051375	3588664.29	581380	13729375
elec.dg.cost	63	357819.94	230000	458734.46	12000	3049600
elec.cost	66	4576465.27	3107643	3687799.52	78271	14209375
bua	68	2020.03	1633.5	1232.83	450	4500
car.con	4	405.25	386.5	212.48	180	668
floors	2	2	2	0	2	2
empden	57	0.07	0.05	0.04	0.03	0.17
emp	57	139.12	90	136.89	40	750
nbeds	66	86.41	72.5	48.34	15	220
opd.day	44	101.2	68.5	104.32	25	525
ppatients	1	0.8	0.8	<NA>	0.8	0.8
tot.tr	6	76.5	52.5	60.64	23	152
ar.tr	4	4.84	4.2	2.05	3.15	7.83
bua.emp	57	19.04	18.66	8.71	5.88	39.17
bua.bed	66	25.4	22.56	12.05	4.58	65.22
emp.bed	57	1.54	1.31	0.89	0.56	5.33

Large Hospitals

No. of observations = 57

Var. name	obs.	mean	median	s.d.	min.	max.
epi	56	304.73	270.23	138.44	114.79	687.15
elec.pur	44	4263603.7	3725000	2237287.97	1285000	7892000
elec.dg	42	102573.95	49804	155025.61	0	9e+05
kwh	56	4429542.9	4150455	2236541.77	1220000	9166000
con.load	47	1168.4	1200	658.25	150	2553
con.dem	17	1181.12	1100	550.67	370	2550
dg	11	1575	1140	820.36	500	3000
elec.pur.cost	43	26181404.26	18300000	20662250.37	6e+06	9e+07
elec.dg.cost	41	971673.76	490000	1330013.27	15000	7200000
elec.cost	49	26482897.69	19500000	20002564.36	5383860	90200000
bua	56	17134.41	15230.5	10935.67	5000	46452
car.con	13	14060.38	10878	9201.47	484	30478
floors	10	7.8	8.5	3.19	3	12
empden	33	0.03	0.03	0.02	0.01	0.08
emp	33	480.85	300	442.03	63	1700
nbeds	45	287.02	225	216.26	75	1100
opd.day	26	238.08	167.5	198.11	75	800
ppatients	5	0.74	0.7	0.13	0.59	0.9
tot.tr	22	600.36	587.5	339.6	44	1660
ar.tr	11	22.63	18.92	9.29	12.46	39.83
bua.emp	33	43.14	33.77	29.92	13	125
bua.bed	45	68.33	60.44	36.56	20.1	164.92
emp.bed	32	2.04	1.69	1.13	0.48	4.75

Table 3-17:

3.17.5. Energy source characteristics

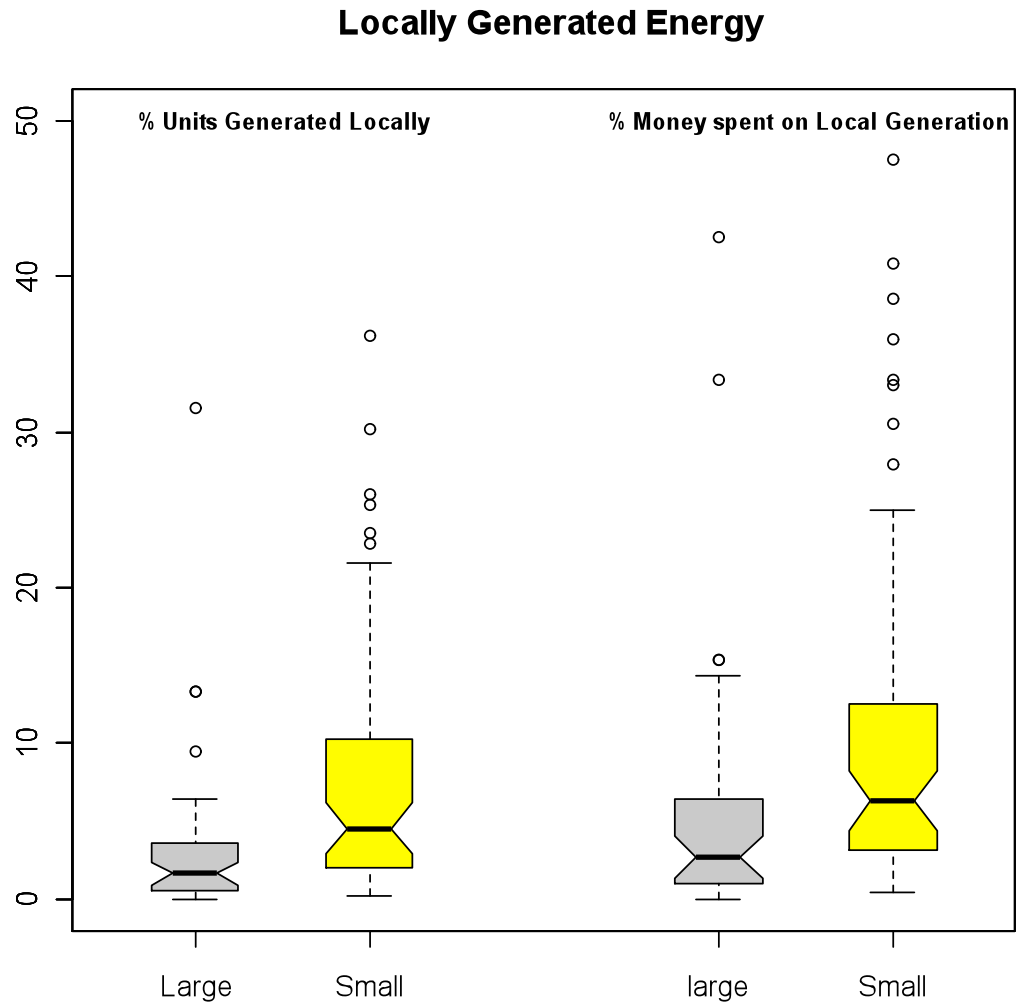


Figure 3-28

% Energy generated by DG / GG set (elec.dg*100/kwh)

	Group.1	count..	mean..	median..	sd..	min..	max.
1	Large	42	3.265	**1.642**	5.468	0.0000	31.58
2	Small	63	7.530	**4.544**	8.283	0.2217	36.16

% Energy Bill spend on DG / GG set generated power `(elec.dg.cost*100/elec.cost)`

	Group.1	count..	mean..	median..	sd..	min..	max.
1	Large	41	5.772	**2.695**	8.596	0.02068	42.48
2	Small	63	10.514	**6.323**	11.235	0.39841	47.54

Table 3-18:

The dependency of small hospitals on locally generated power is almost three times the dependency of large hospitals. Further, the variation is smaller in larger hospitals

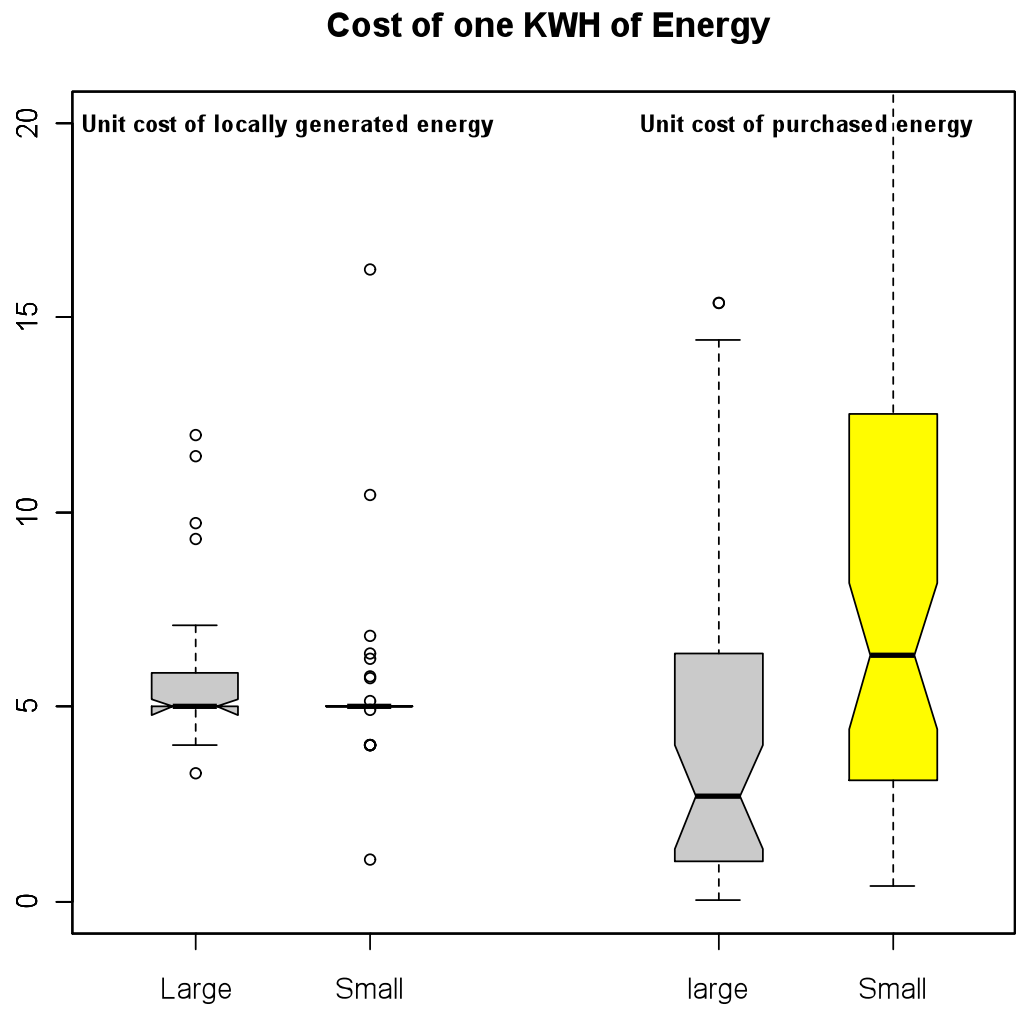


Figure 3-29

Unit Cost of Locally Generated Energy (elec.dg.cost/elec.dg)

	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	NA's
Large	3.305	5.000	**5.000**	5.719	5.883	12.000	2.000
Small	1.073	5.000	**5.000**	5.982	5.000	55.060	1.000

Unit Cost of Purchased Energy (elec.pur.cost/elec.pur)

	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	NA's

Large	0.02068	1.01800	**2.69500**	5.77200	6.39100	42.48000	16.00000
Small	0.3984	3.1120	**6.3230**	10.5100	12.5500	47.5400	6.00000

Table 3-19: *<<More data needed to confirm this>>*

3.17.6. EPI

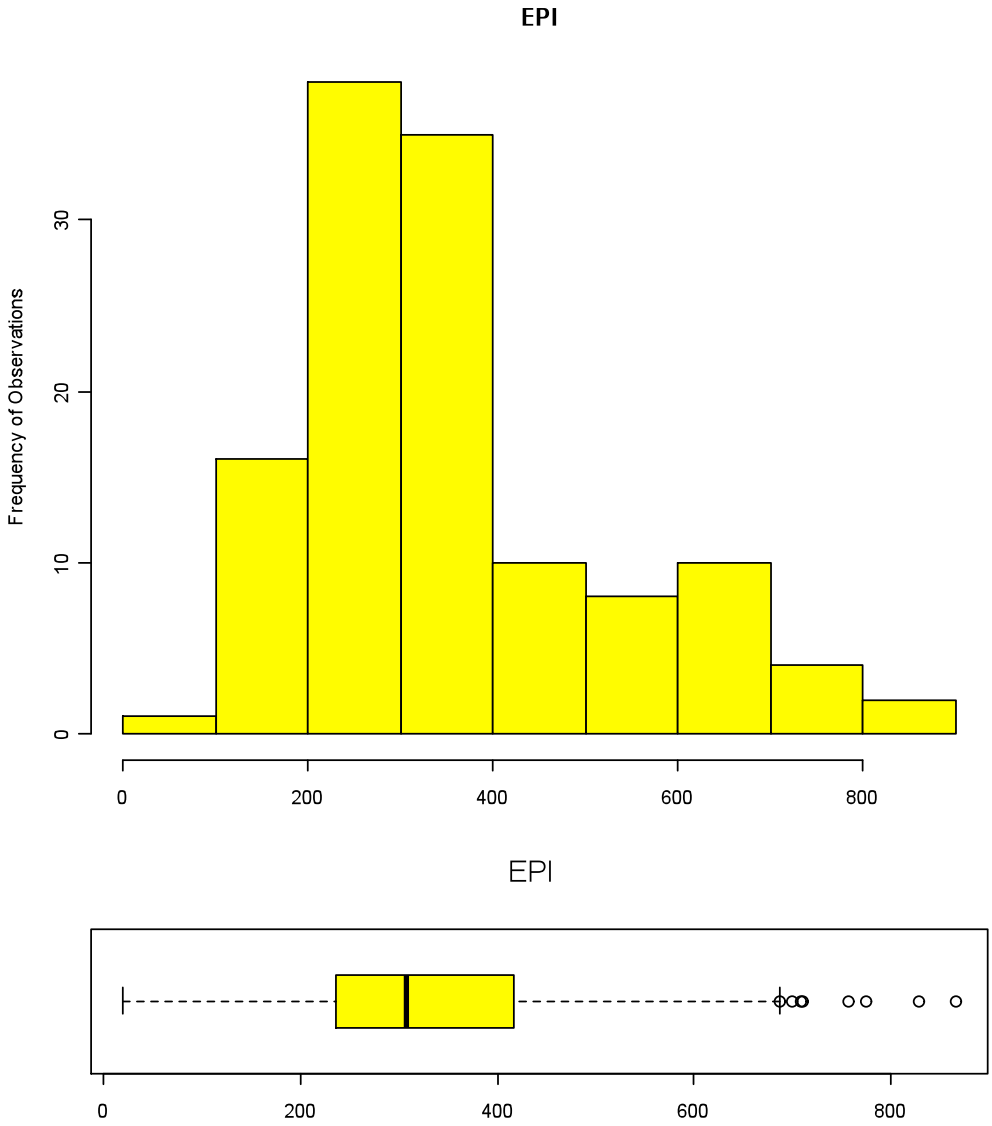


Figure 3-30

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	NA's
20.33	238.00	307.00	353.60	414.00	865.00	1.00

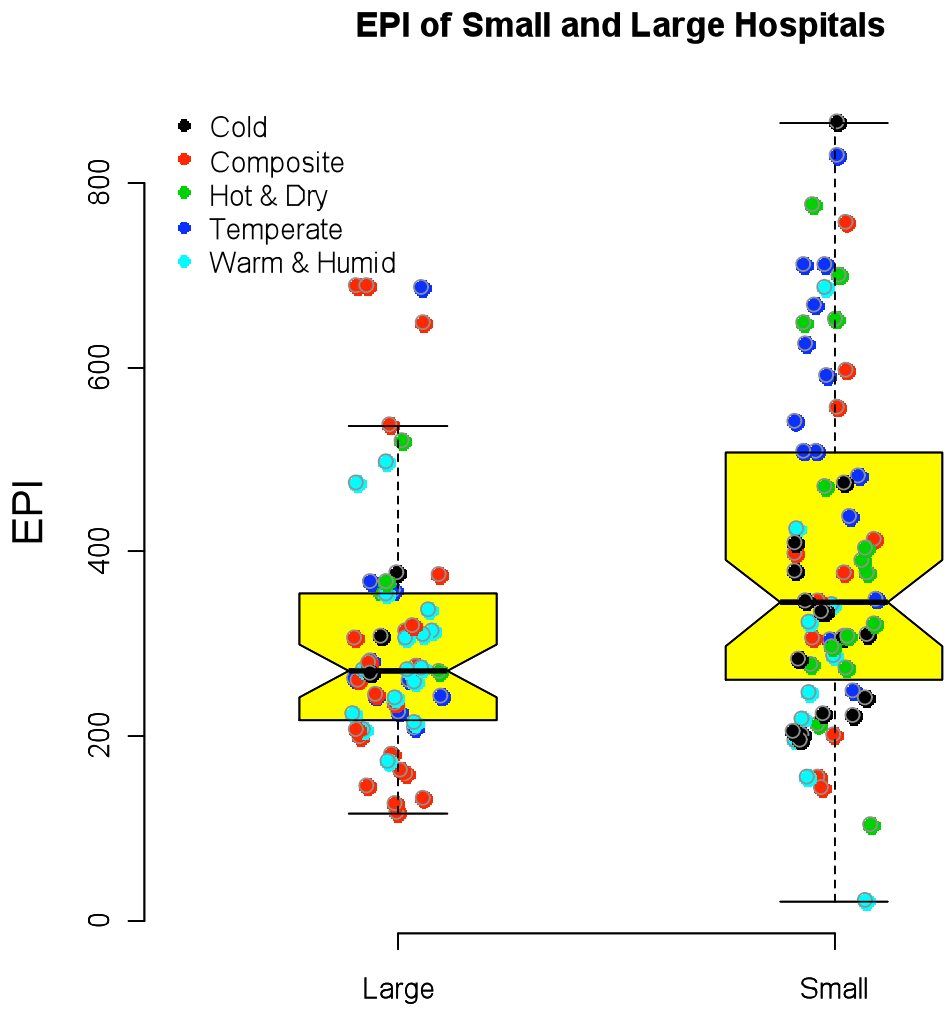


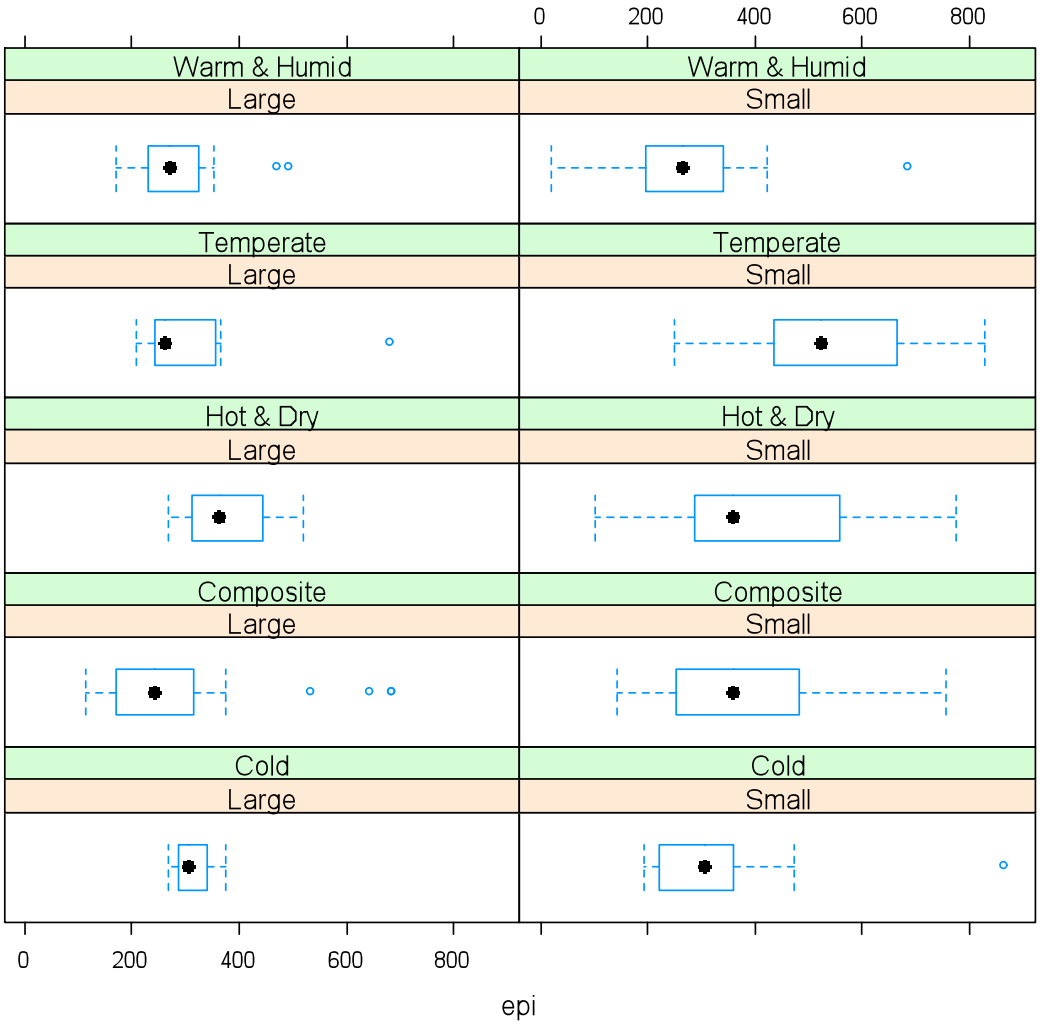
Figure 3-31

EPI		count	mean	median	sd	min	max
	All	124	353.55	**307.04**	173.93	20.33	864.97
1	Large	56	304.73	**270.23**	138.44	114.79	687.15
2	Small	68	393.76	**344.26**	190.18	20.33	864.97

Table 3-20:

Large Multi specialty hospitals have smaller EPI and the difference is statistically significant.

3.17.7. EPI and climate



3.17.8. Energy Consumptions and Size of Hospital

Do larger hospitals consume less energy per unit area/bed?

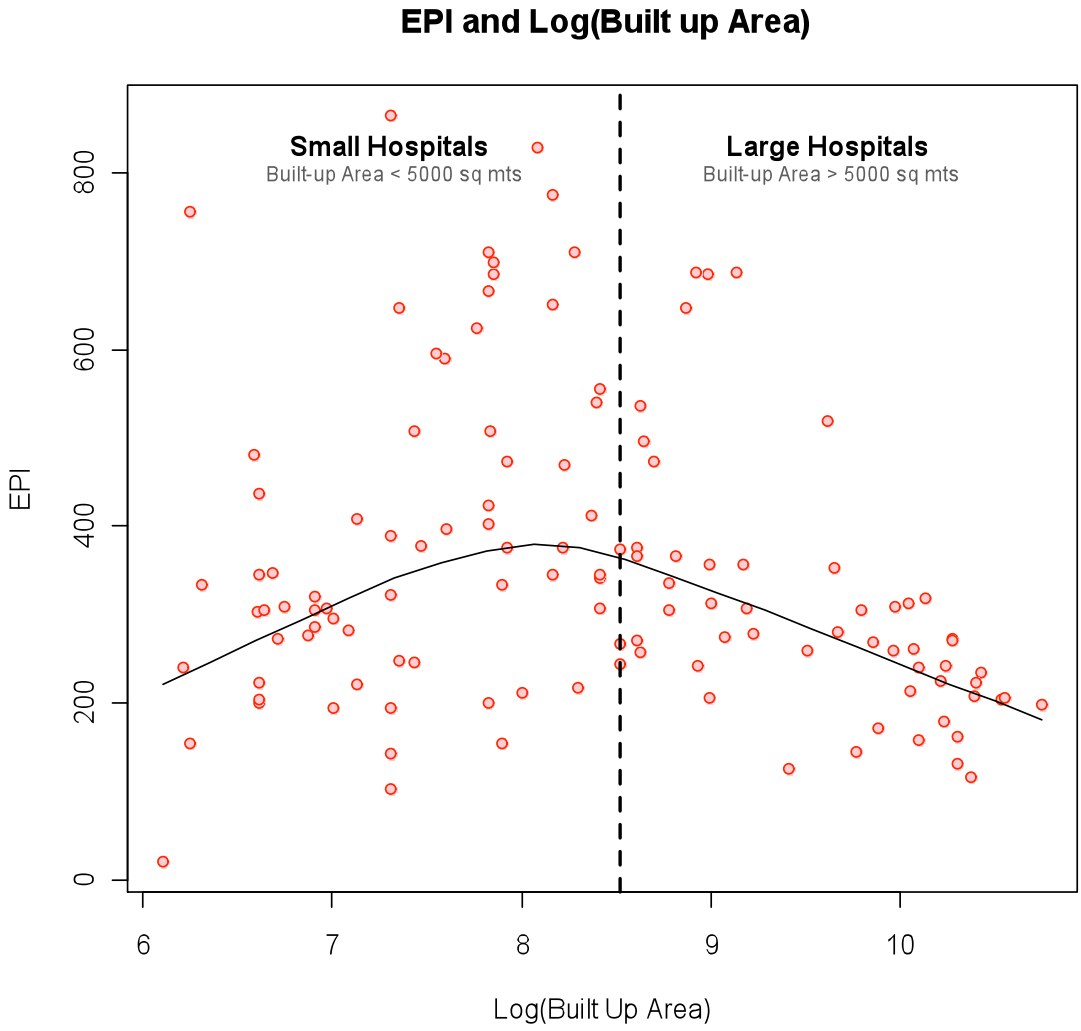


Figure 3-32

EPI increases with BUA for small hospitals and vice versa for large hospitals.

Note: It is possible that 3000 sq mts (instead of 5000 sq mts) is a better cutoff for determining small and big hospitals. This should be checked statistically

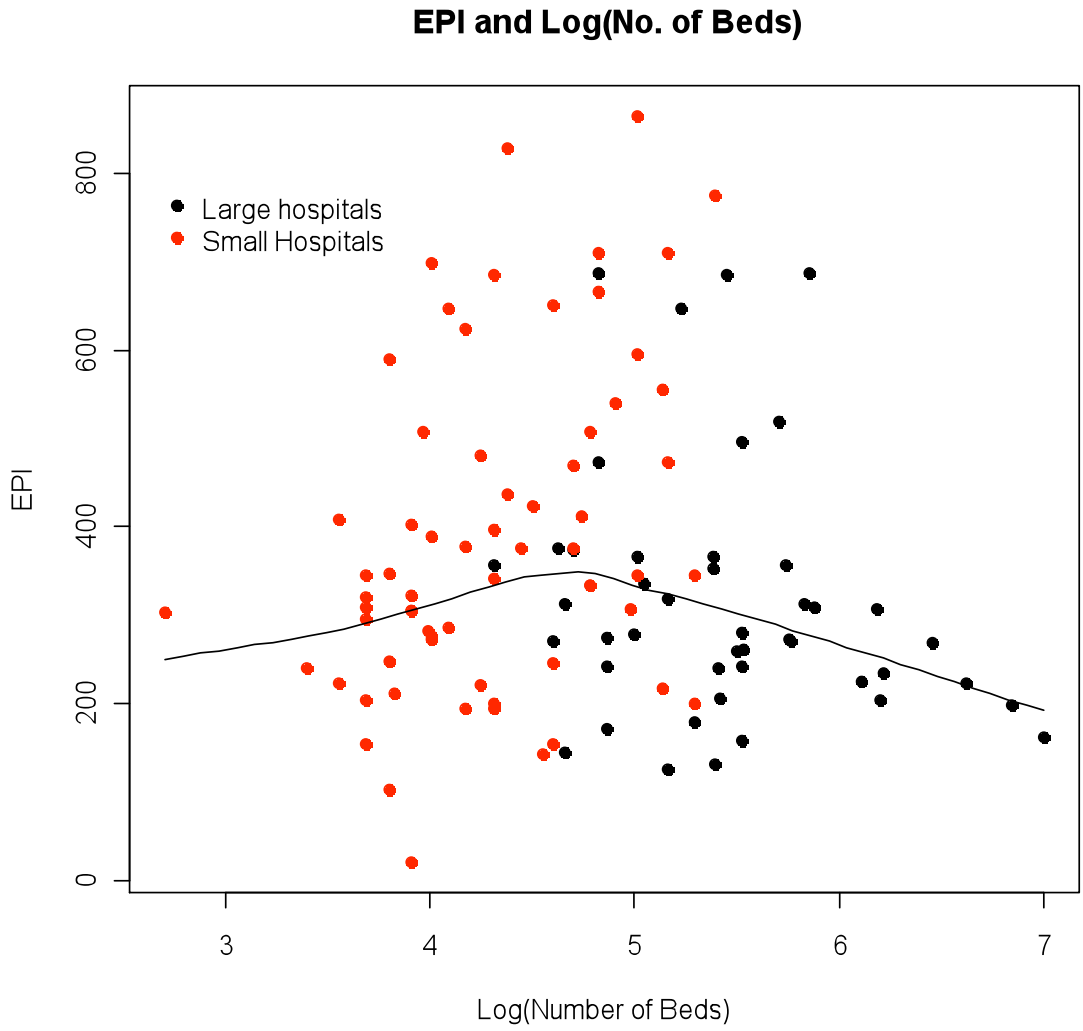

EPI and Log(No. of Beds)
Large hospitals
Small Hospitals
EPI
0
200
400
600
800
3
4
5
6
7
Log(Number of Beds)

Figure 3-33

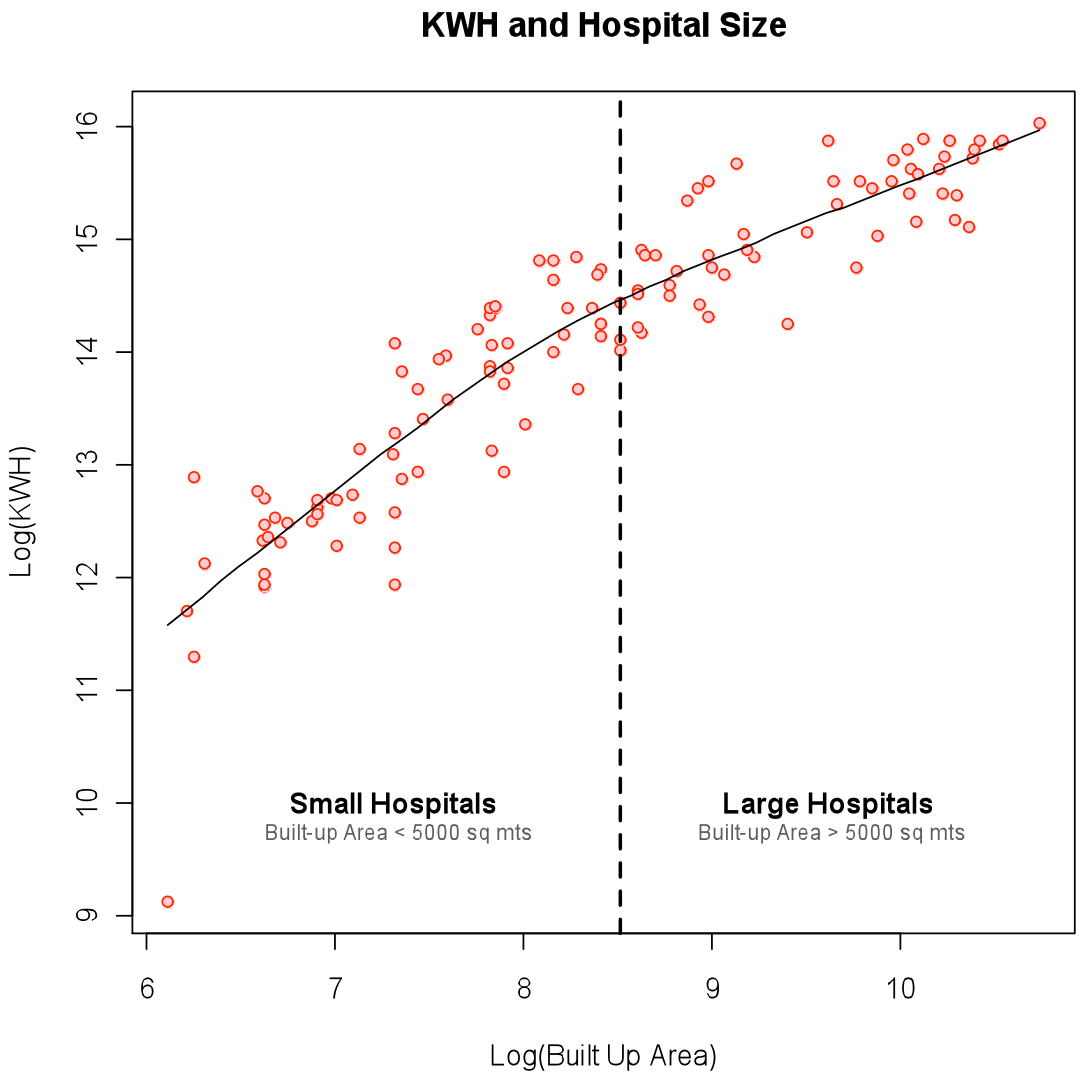

KWH and Hospital Size
Log(KWH)
9
10
11
12
13
14
15
16
Small Hospitals
Built-up Area < 5000 sq mts
Large Hospitals
Built-up Area > 5000 sq mts
6
7
8
9
10
Log(Built Up Area)

Figure 3-34

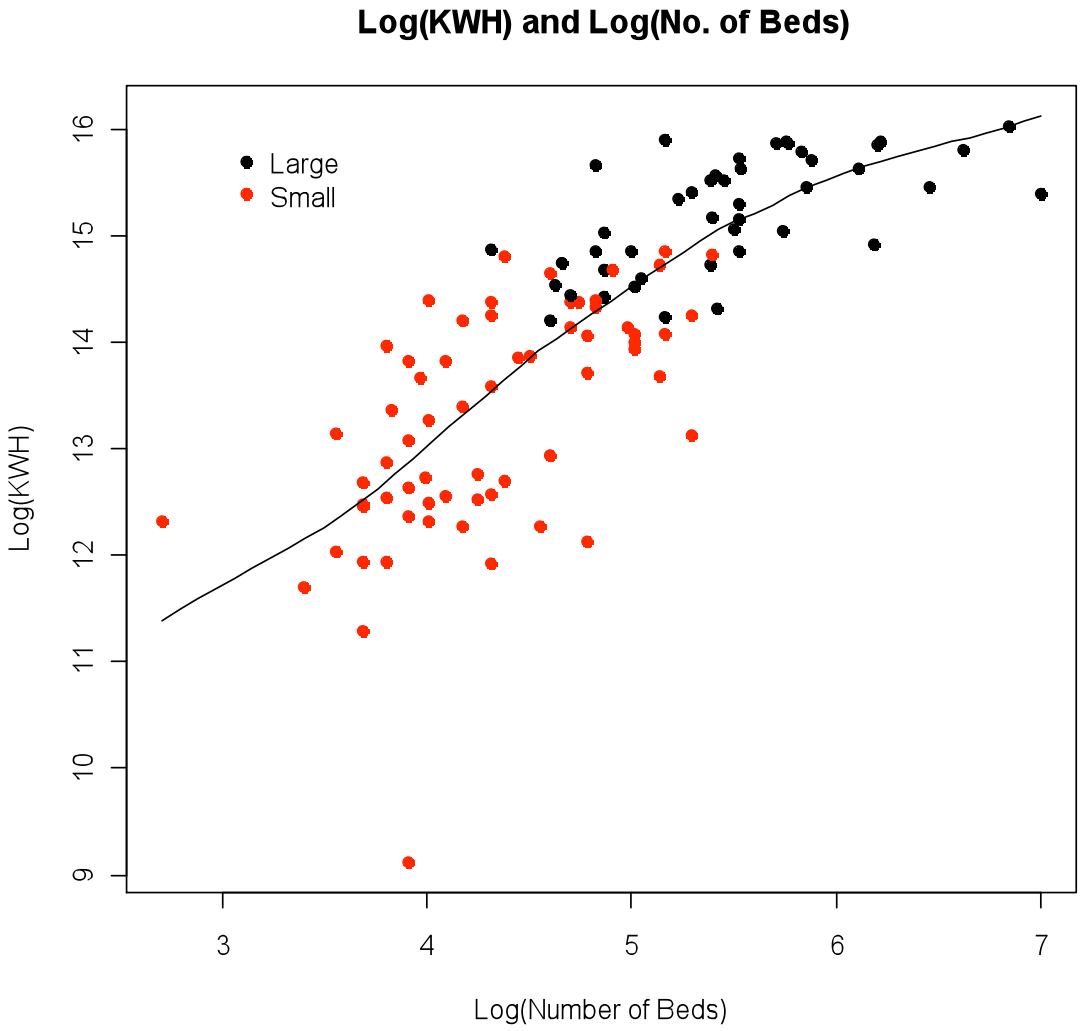

Log(KWH) and Log(No. of Beds)
Large
Small
Log(KWH)
9
10
11
12
13
14
15
16
3
4
5
6
7
Log(Number of Beds)

Figure 3-35

4.Sector Specific Data: Hotel

4.1. Initial Summary

No. of observations = 184

	Var. name	obs.	mean	median	s.d.	min.	max.
3	epi	182	272.28	240.72	198.35	6	1685.39
4	epi.p.h	119	0	0	0	0	0
5	epi.h	153	0.03	0.03	0.02	0	0.19
12	elec.pur	154	2834575.77	1519916	3542565.25	35750	17280000
13	elec.dg	123	134496.9	50000	341303.71	0	2770000
14	kwh	184	2915008.68	1475737	3764233.45	35750	20019000
15	con.load	37	1168.85	875	1276.58	10.8	5452
16	con.dem	150	898.43	502	991.01	100	6282
17	dg	72	1122.78	1000	982.42	34	5196
18	elec.pur.cost	141	17715804.79	7800000	26640582.84	3e+05	137250400
19	elec.dg.cost	117	1127674.62	550000	2204614.89	0	17128896
20	elec.cost	152	18414808.37	8090500	27302467.28	0	151759160
21	bua	182	12709.31	5926.5	19930.89	150	189175
22	car.con	111	9612.04	5000	12432.57	120	65000
23	floors	35	8.2	6	6.47	2	30
26	empden	119	0.05	0.03	0.05	0	0.32
35	emp	120	211.26	130	217.83	30	1100
37	nrooms	145	117.23	80	98.18	24	520
38	visitors	70	39521.94	11591.5	91434.3	3500	576748
39	prooms	31	0.69	0.69	0.14	0.27	0.95
43	tot.tr	71	519.94	332	475.07	6	2100
44	ar.tr	47	27.73	21.82	20.59	6.16	129.87
45	bua.emp	119	42.31	32.87	41.28	3.16	311.11

Table 4-1:

4.2. Empden

Original Density / Box plot	Data count
	184

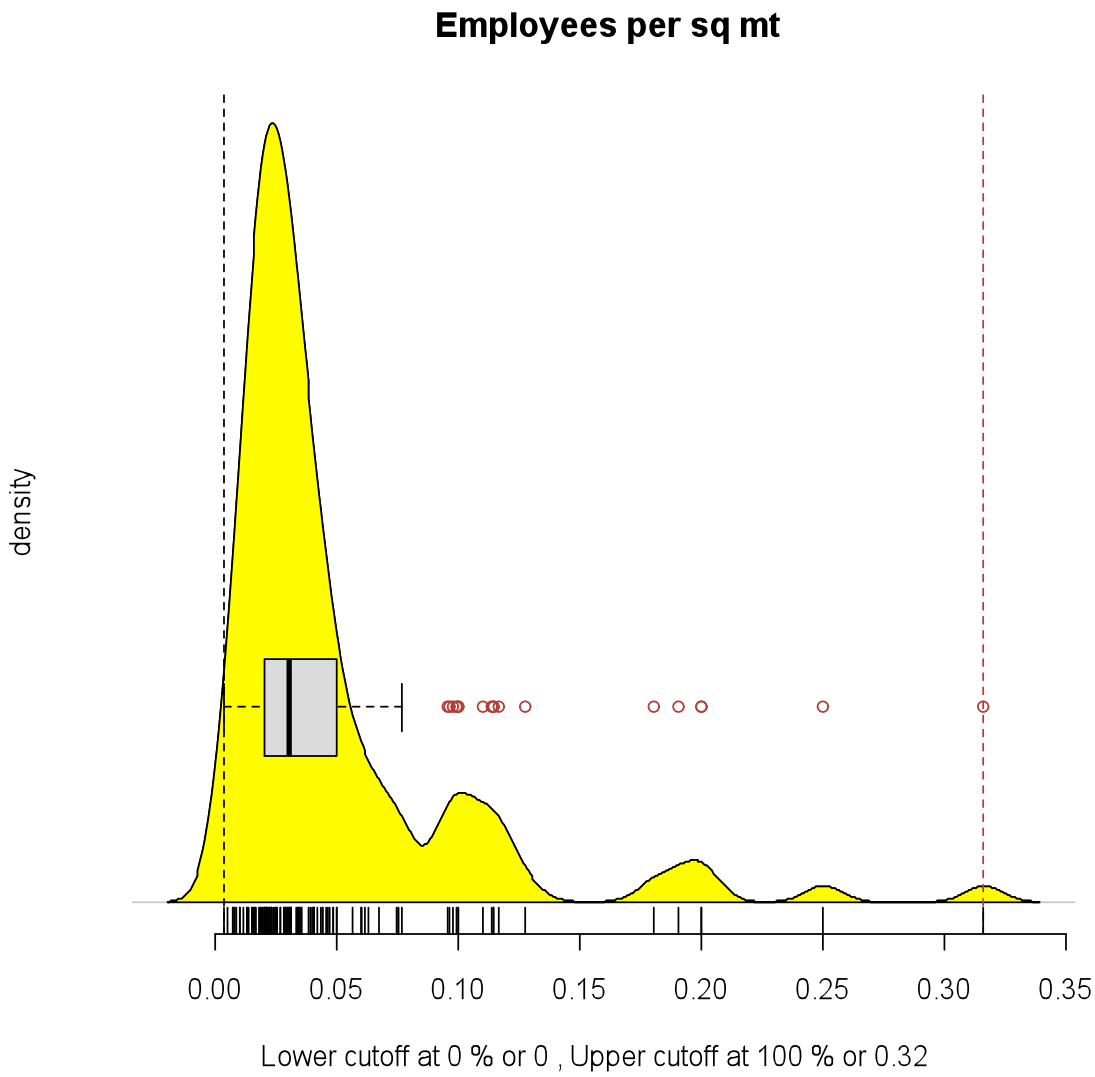
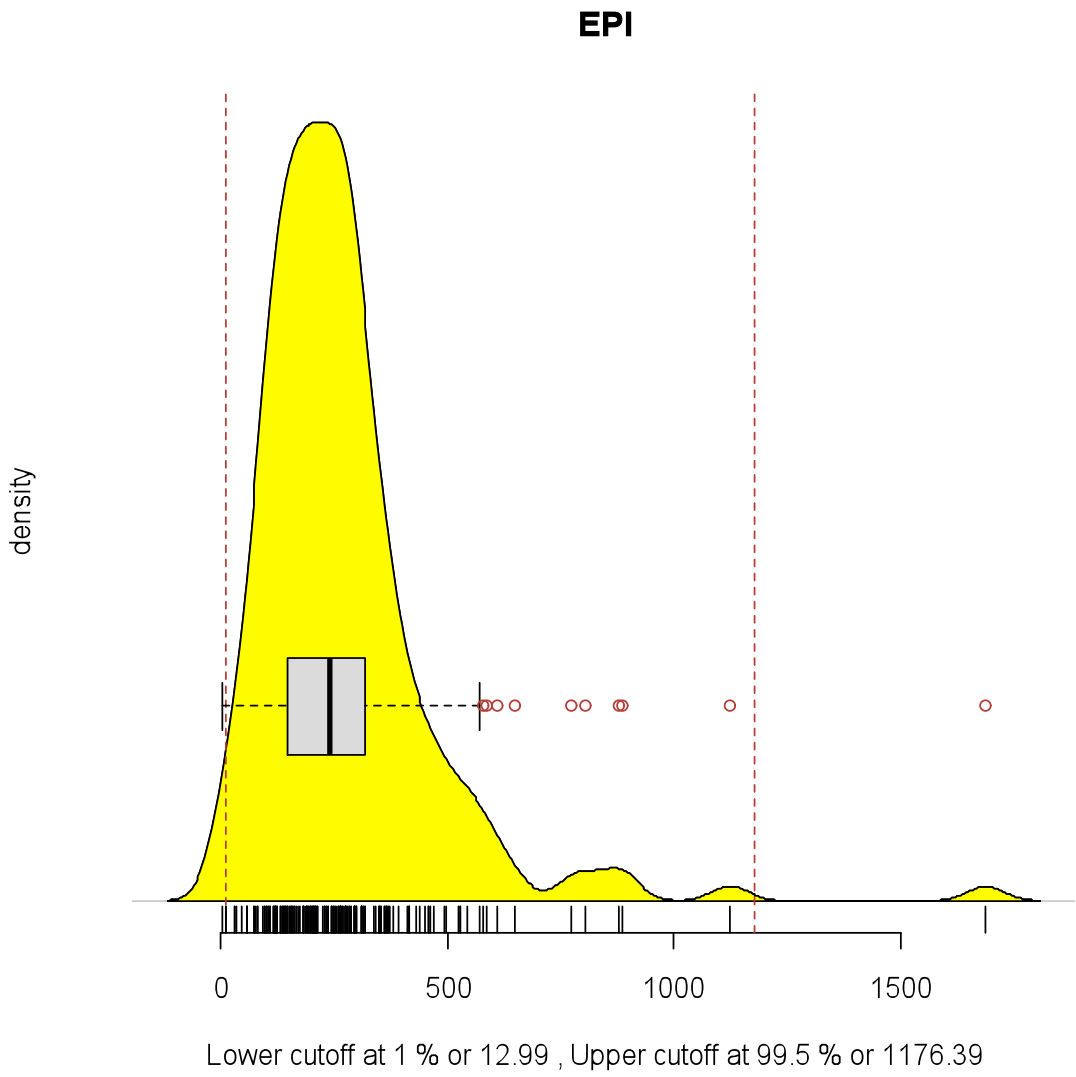


Figure 4-1

```
Original
     Min.   1st Qu.    Median      Mean   3rd Qu.      Max.      NA's
 0.003214  0.020160  0.030420  0.047760  0.050000  0.316000 65.000000
```

4.3. EPI

Original Density / Box plot	Data count
	184



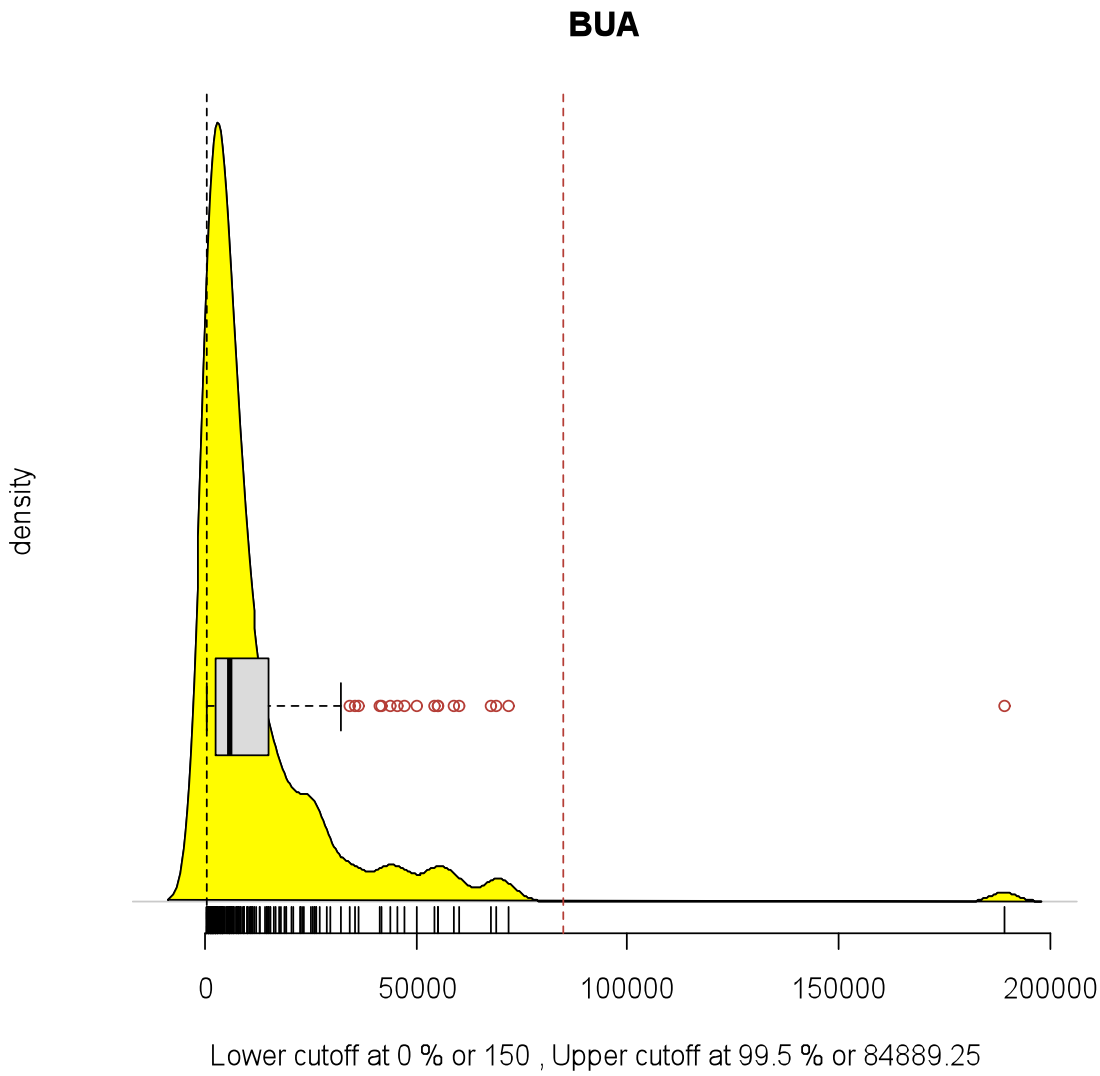
Observations: BID 101,405,692	184
Action: Values of KWH, BUA set to 'NA'	

Figure 4-2

```
Original
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NA's
   6.0   149.5   240.7   272.3   319.9  1685.0     2.0
Modified
   Min.  1st Qu.  Median    Mean 3rd Qu.    Max.    NA's
   13.22  154.30  245.00  267.30  319.80 1123.00    5.00
```

4.4. BUA

Original Density / Box plot	Data count
	179
	Lower cutoff
	179
	Upper cutoff
	178



Observations: BID 85	184
Action: Values of BUA set to 'NA'	

Figure 4-3

```
Original
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NA's
    150    2220    5909   12720   14820  189200       5
Modified
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NA's
    150    2210    5797   11730   14700   72000       6
```

4.5. EMP

Original Density / Box plot	Data count
	184

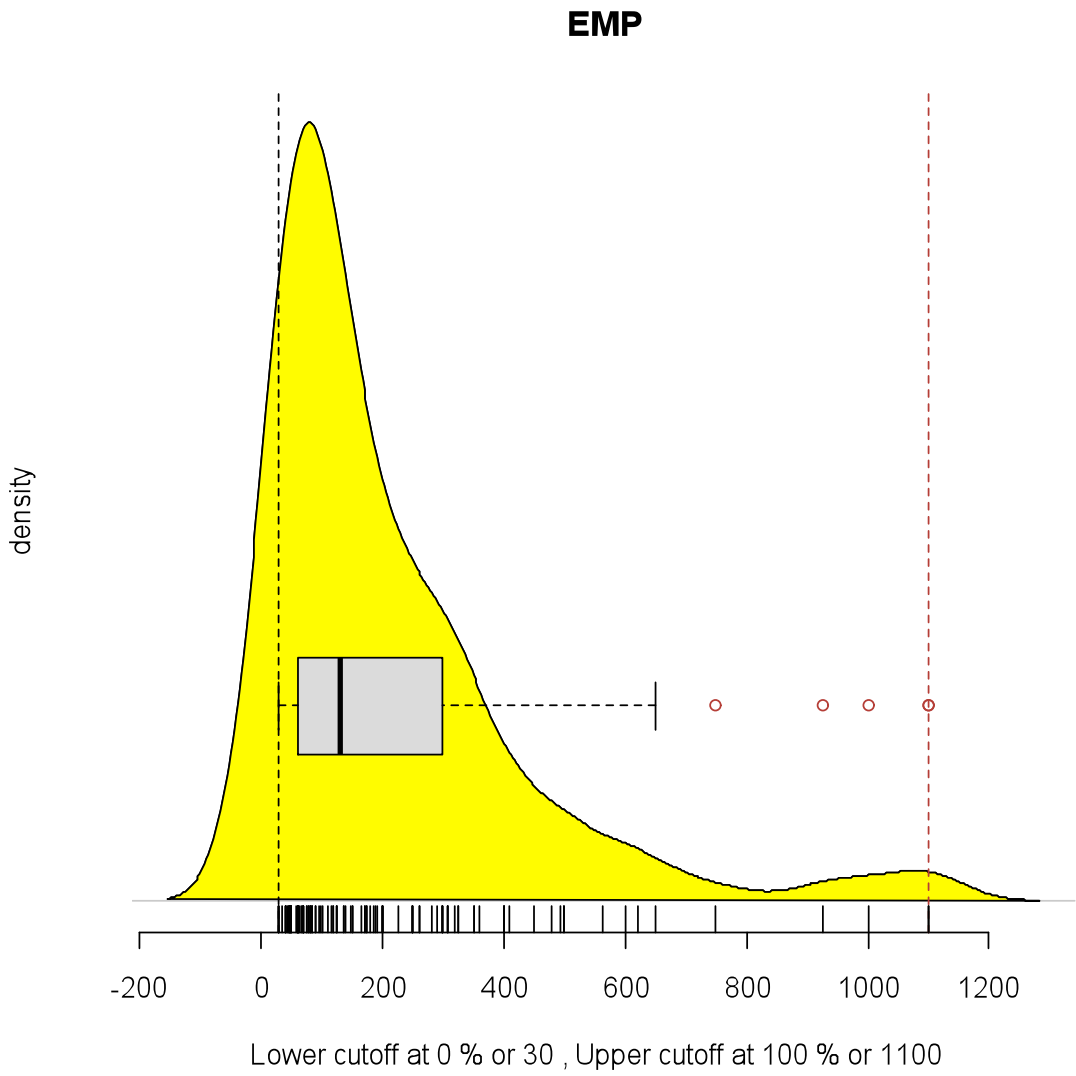
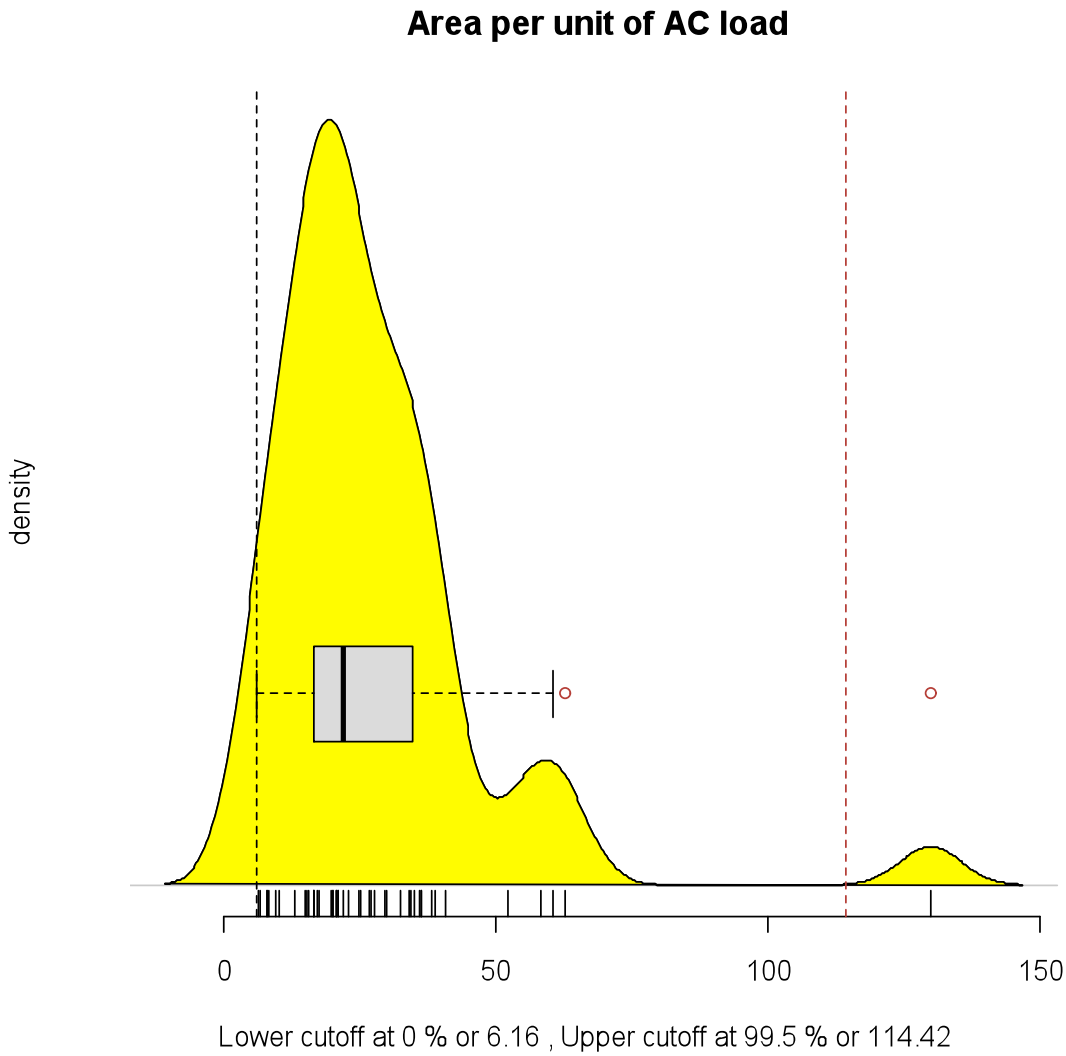


Figure 4-4

```
Original
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NA's
  30.00   62.25  130.00  211.30  300.00 1100.00   64.00
```

4.6. Area per TR of AC

Original Density / Box plot	Data count
	184



Observations: BID 101 184

Action: Values of tot.tr set to 'NA'

Figure 4-5

```
Original
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NA's
  6.158  16.470  21.820  27.730  34.720 129.900 137.000
Modified
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NA's
  6.158  16.430  21.370  25.510  34.260  62.680 138.000
```

4.7. Number of Rooms

Original Density / Box plot	Data count
	184

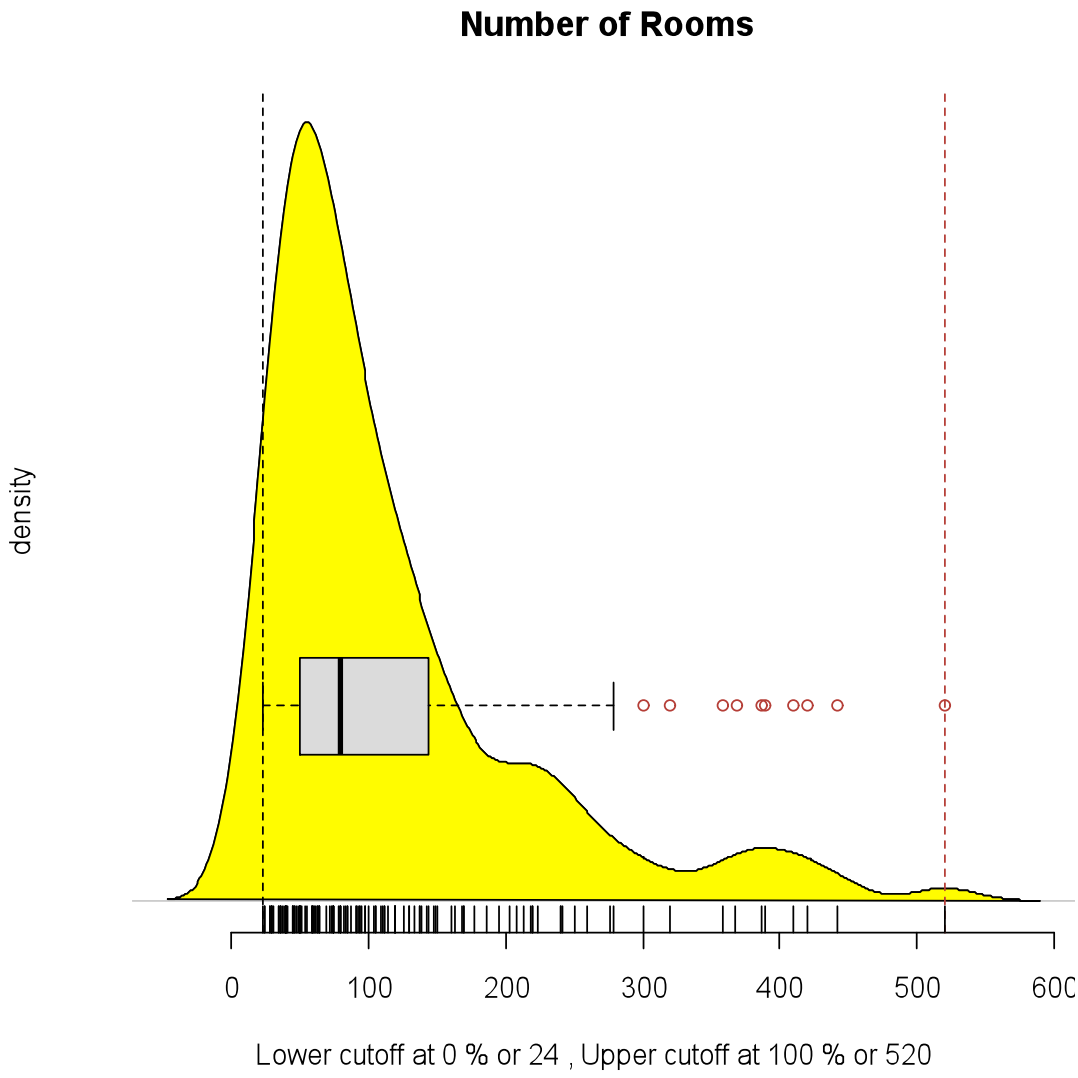
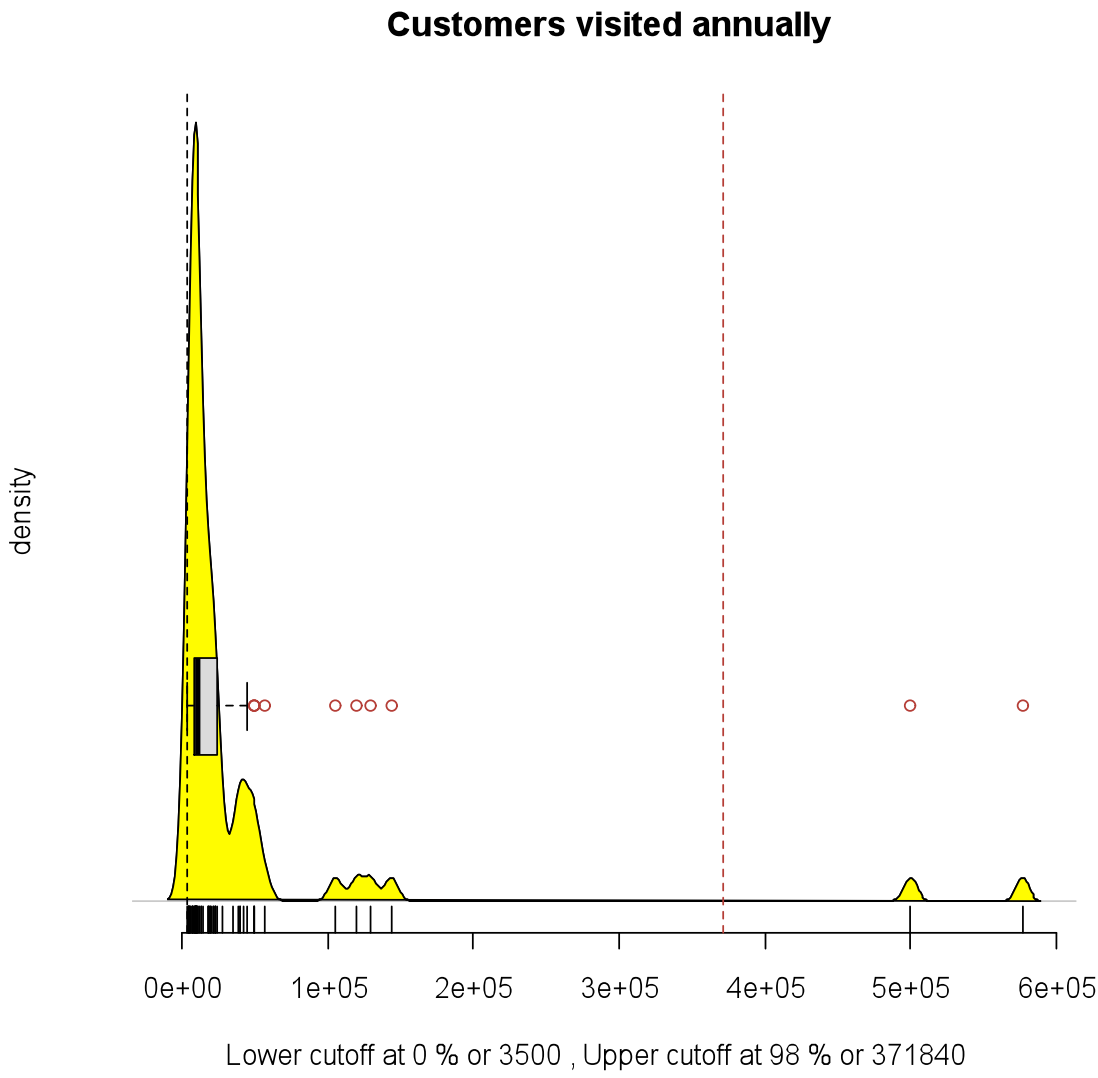


Figure 4-6

```
Original
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NA's
   24.0    50.0    80.0   117.2   144.0   520.0    39.0
```

4.8. Customers visited annually

Original Density / Box plot	Data count
	178
	Lower cutoff
	178
	Upper cutoff
	176



Observations: BID 503, 512 — 184

Action: Values of visitors set to 'NA'

Figure 4-7

```
Original
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NA's
   3500    9250   11590   39520   26720  576700     114
Modified
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NA's
   3500    9000   11120   24850   23580  144000     116
```

4.9. % Guests overnight in a year

Original Density / Box plot	Data count
	184

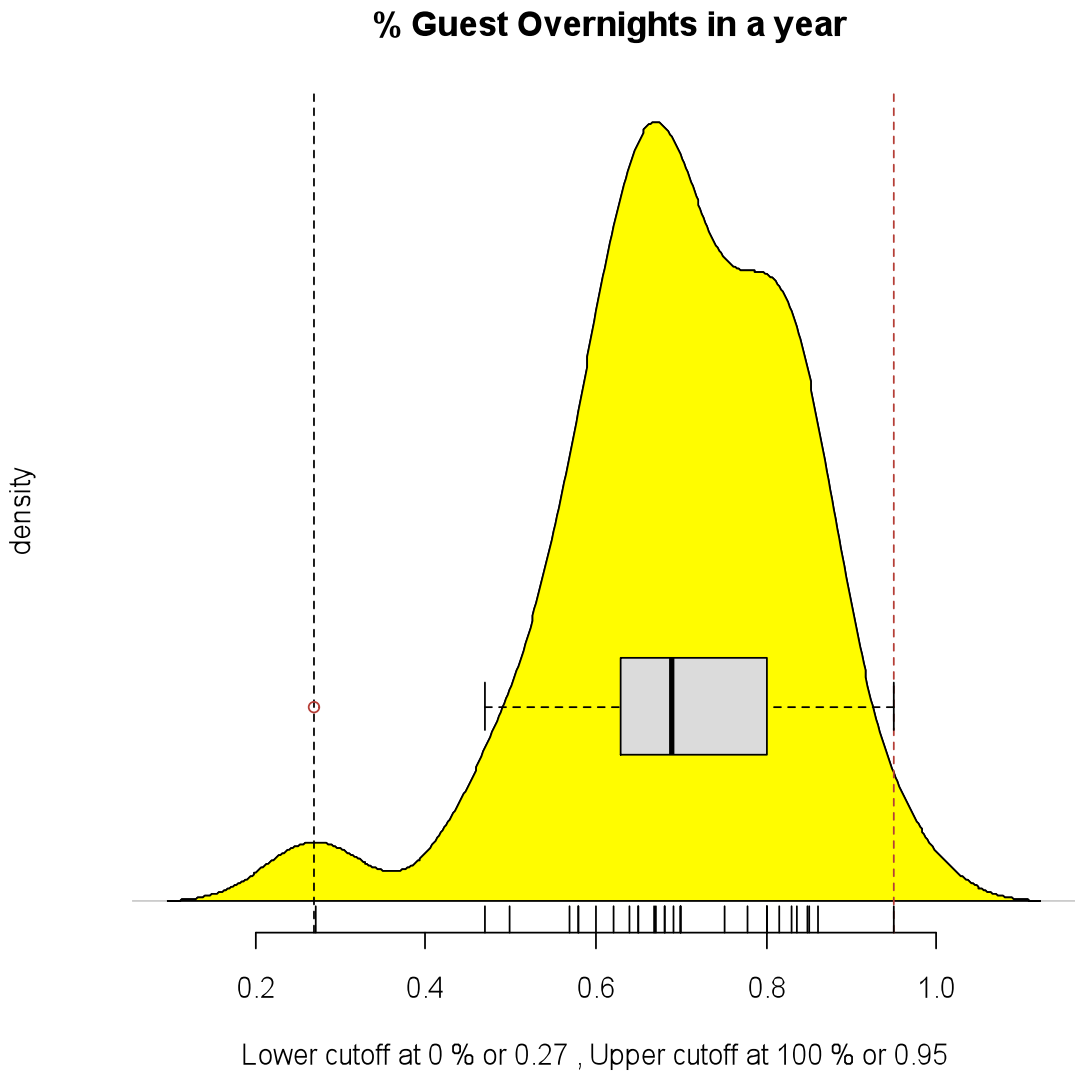


Figure 4-8

```
Original
    Min.  1st Qu.   Median     Mean  3rd Qu.     Max.     NA's
  0.2700   0.6300   0.6900   0.6948   0.8000   0.9500 153.0000
```

4.10.Final Summary

4.10.1. Summary

No. of observations = 184

	Var. name	obs.	mean	median	s.d.	min.	max.
3	epi	178	268.63	245.08	166.85	13.22	1122.96
4	epi.p.h	119	0	0	0	0	0
5	epi.h	152	0.03	0.03	0.02	0	0.13
12	elec.pur	154	2834575.77	1519916	3542565.25	35750	17280000
13	elec.dg	123	134496.9	50000	341303.71	0	2770000
14	kwh	181	2953045.02	1476474	3782720.71	35750	20019000
15	con.load	37	1168.85	875	1276.58	10.8	5452
16	con.dem	150	898.43	502	991.01	100	6282
17	dg	72	1122.78	1000	982.42	34	5196
18	elec.pur.cost	141	17715804.79	7800000	26640582.84	3e+05	137250400
19	elec.dg.cost	117	1127674.62	550000	2204614.89	0	17128896
20	elec.cost	152	18414808.37	8090500	27302467.28	0	151759160
21	bua	178	11731.42	5797	15106.74	150	72000
22	car.con	111	9612.04	5000	12432.57	120	65000
23	floors	35	8.2	6	6.47	2	30
26	empden	119	0.05	0.03	0.05	0	0.32
35	emp	120	211.26	130	217.83	30	1100
37	nrooms	145	117.23	80	98.18	24	520
38	visitors	68	24849.82	11116.5	30313.21	3500	144000
39	prooms	31	0.69	0.69	0.14	0.27	0.95
43	tot.tr	70	525.17	334	476.44	6	2100
44	ar.tr	46	25.51	21.37	14.02	6.16	62.68
45	bua.emp	119	42.31	32.87	41.28	3.16	311.11

Table 4-2:

4.10.2. Subtype

4 and 5 Star (Luxury)
48

Table 4-3:

4.10.3. Climatic Zones and Conditioning status

No. of observations	Conditioned	Unconditioned	NA	Total
Cold	12	0	10	22
Composite	32	0	19	51
Hot & Dry	5	1	19	25
Temperate	20	2	8	30
Warm & Humid	34	1	21	56
Total	103	4	77	184

Table 4-4:

4.10.4. Ownership

No. of observations	Conditioned	Unconditioned	NA	Total
Private	103	4	76	183
Public	0	0	1	1
Total	101	4	77	184

Table 4-5:

4.10.5. Shifts

2 shifts	3 shifts	<NA>
2	162	20

Table 4-6:

From this point onwards, it is assumed that all hospitals in the sample operate in 3 shifts and are fully conditioned

4.10.6. Profile of all Hotels

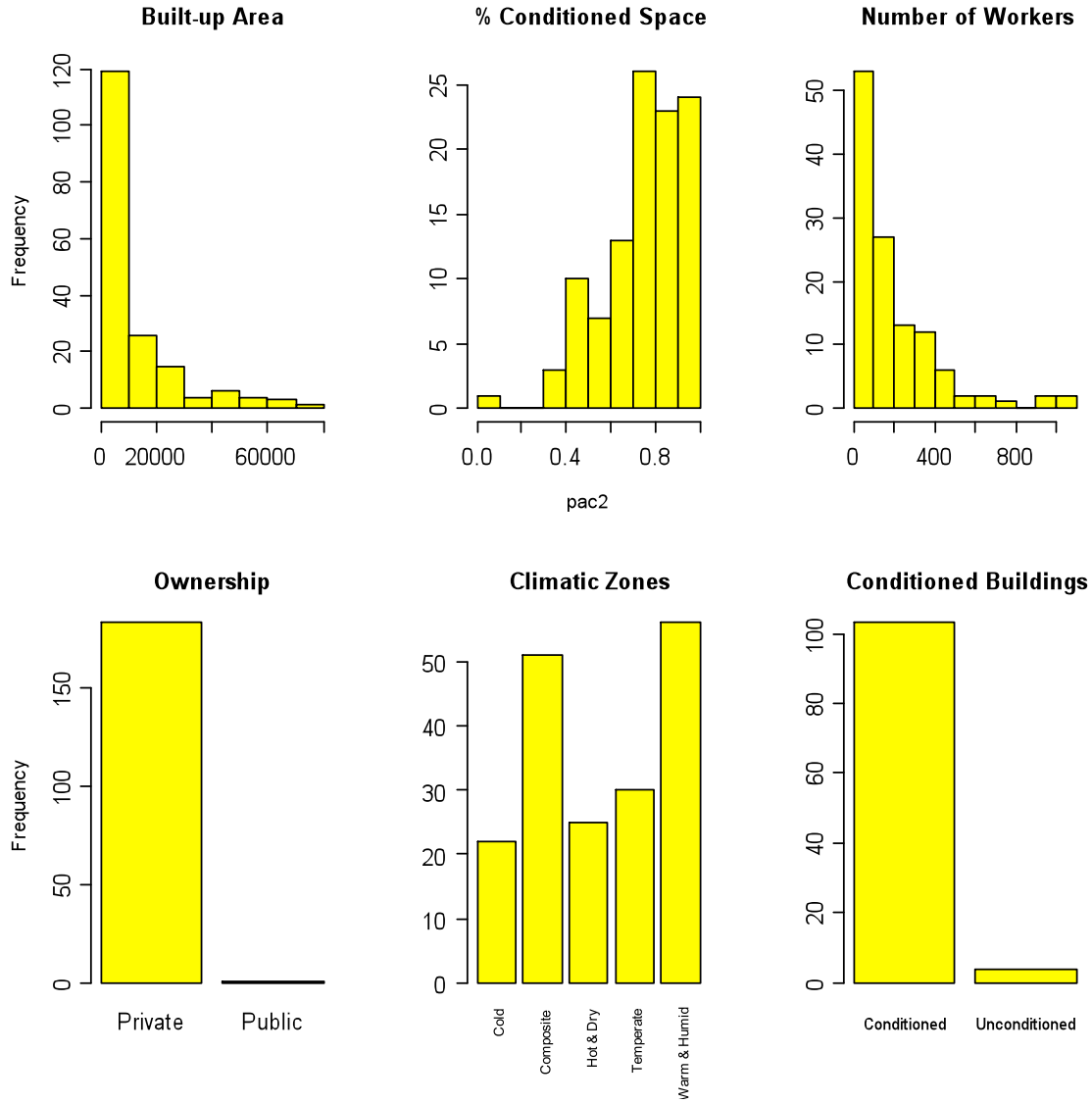


Figure 4-9

4.10.7. Profile of Luxury and Non luxury Hotels

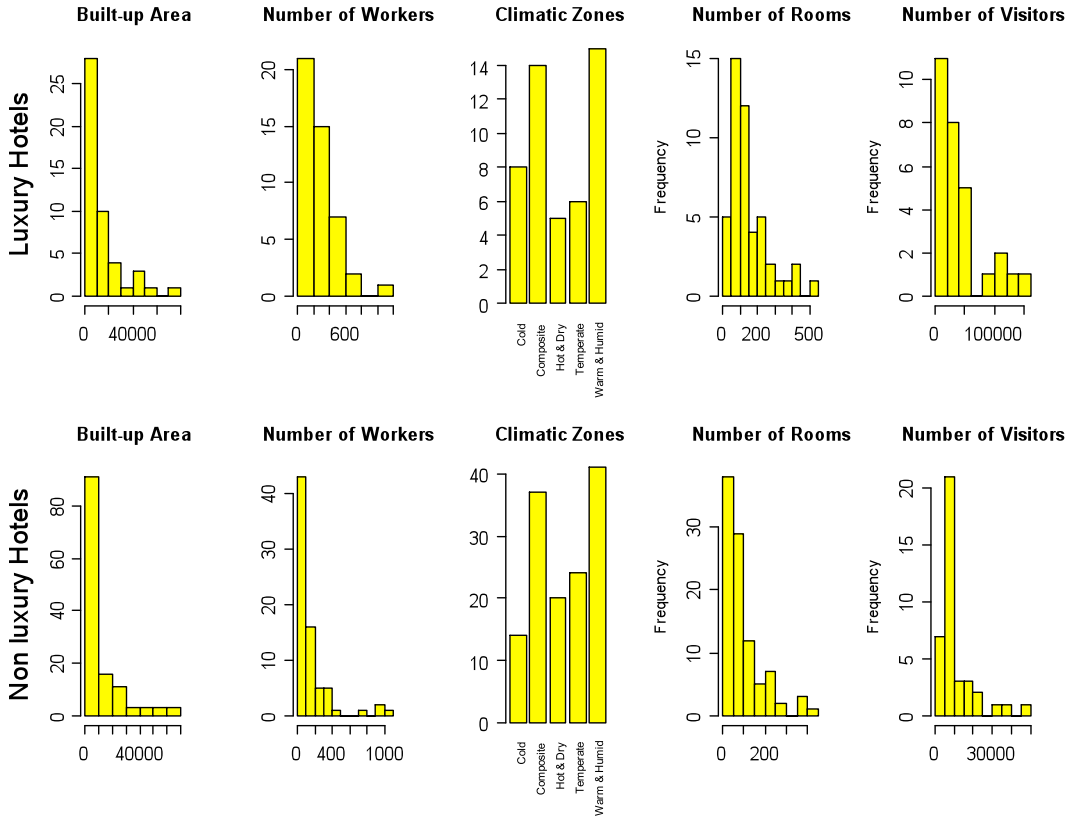


Figure 4-10

Summary of Luxury and Non Luxury Hotels

No. of observations = 48

	Var. name	obs.	mean	median	s.d.	min.	max.
3	epi	48	274.19	210.95	153.98	57.76	878.86
4	epi.p.h	46	0	0	0	0	0
5	epi.h	48	0.03	0.02	0.02	0.01	0.1
12	elec.pur	47	3495070.66	1981770	3626900.39	77116	13980180
13	elec.dg	45	75762.51	43944	87449.3	416	433200
14	kwh	48	3513422.92	2074108	3595923.77	77532	13980180
15	con.load						
16	con.dem	48	1078.58	707.5	959.25	100	4099
17	dg	7	1354.71	1000	1154.86	110	3250
18	elec.pur.cost	45	21024691.4	10805081	26497689.33	481204	129384430
19	elec.dg.cost	45	1416729.73	684108	2714369.89	0	17128896
20	elec.cost	48	21995103.15	11541673.5	26064411.6	507182	130162430
21	bua	48	14278.02	8037	15681.07	250	72000
22	car.con	29	15082.1	8316	15040.62	200	65000
23	floors						
24	pac2	29	0.8	0.83	0.19	0.09	1
25	pac_i						
26	empden	46	0.04	0.02	0.05	0.01	0.32
35	emp	46	285.09	250	205.53	45	1100
36	occup						
37	nrooms	48	151.1	111	109.78	40	520
38	visitors	29	41470.59	22995	39563.15	4851	144000
43	tot.tr	5	1037.2	1239	440.93	332	1462
44	ar.tr	5	29.28	21.82	14.38	17.1	52.25
45	bua.emp	46	48.4	40.82	33.8	3.16	144
46	subtype2	48	1	1	0	1	1

Non Luxury Hotels

No. of observations = 136

	Var. name	obs.	mean	median	s.d.	min.	max.
3	epi	130	266.59	251.84	171.88	13.22	1122.96
4	epi.p.h	73	0	0	0	0	0
5	epi.h	130	0.03	0.03	0.02	0	0.13

12	elec.pur	107	2544451.84	1200000	3482437.86	35750	17280000
13	elec.dg	78	168382.12	50000	420733.44	0	2770000
14	kwh	133	2750803.37	1200000	3840929.14	35750	20019000
15	con.load	37	1168.85	875	1276.58	10.8	5452
16	con.dem	102	813.66	450	998.98	100	6282
17	dg	65	1097.8	1000	969.1	34	5196
18	elec.pur.cost	96	16164764.2	5639594.5	26703762.24	3e+05	137250400
19	elec.dg.cost	72	947015.18	478500	1813504.64	5250	14504760
20	elec.cost	104	16762364.62	5554831.5	27822294.59	0	151759160
21	bua	130	10791.14	4294.5	14840.36	150	69029
22	car.con	82	7677.5	2702	10826.24	120	57191
23	floors	35	8.2	6	6.47	2	30
24	pac2	78	0.74	0.77	0.18	0.34	1
25	pac_i						
26	empden	73	0.05	0.03	0.05	0	0.25
35	emp	74	165.36	72	213.87	30	1100
36	occup	11	339.27	300	304.78	70	1030
37	nrooms	97	100.46	63	87.77	24	442
38	visitors	39	12490.79	10000	9961.2	3500	50000
39	prooms	31	0.69	0.69	0.14	0.27	0.95
43	tot.tr	65	485.78	300	458.82	6	2100
44	ar.tr	41	25.05	20.92	14.08	6.16	62.68
45	bua.emp	73	38.46	28.89	45.16	4	311.11
46	subtype2	136	2	2	0	2	2

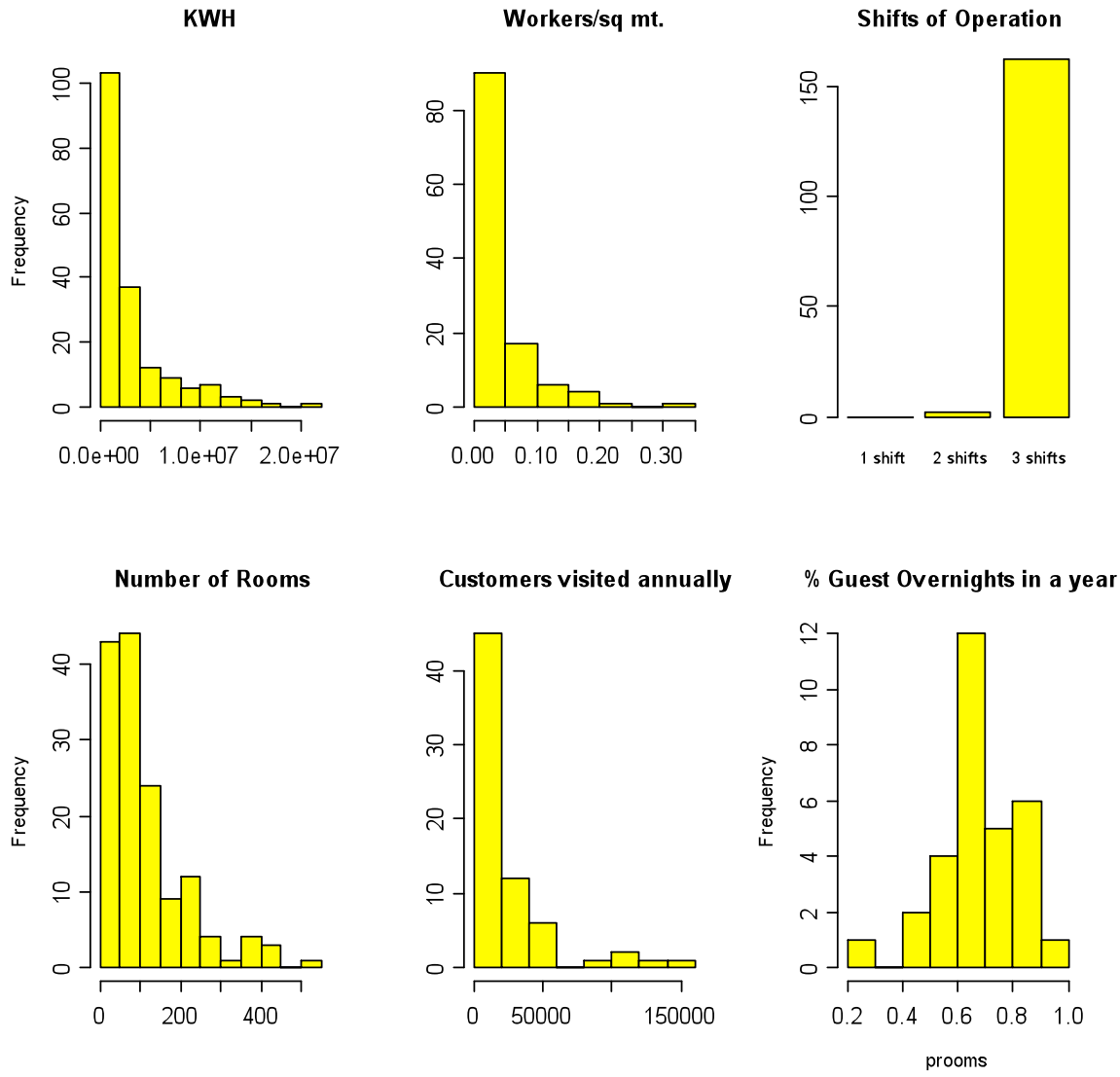

KWH
Frequency
0
20
40
60
80
100
0.0e+00
1.0e+07
2.0e+07
Workers/sq mt.
0
20
40
60
80
0.00
0.10
0.20
0.30
Shifts of Operation
0
50
100
150
1 shift
2 shifts
3 shifts
Number of Rooms
Frequency
0
10
20
30
40
0
200
400
Customers visited annually
0
10
20
30
40
0
50000
150000
% Guest Overnights in a year
Frequency
0
2
4
6
8
10
12
0.2
0.4
0.6
0.8
1.0
prooms

Figure 4-11

4.11.EPI

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	NA's
13.22	156.20	245.10	268.60	319.90	1123.00	6.00

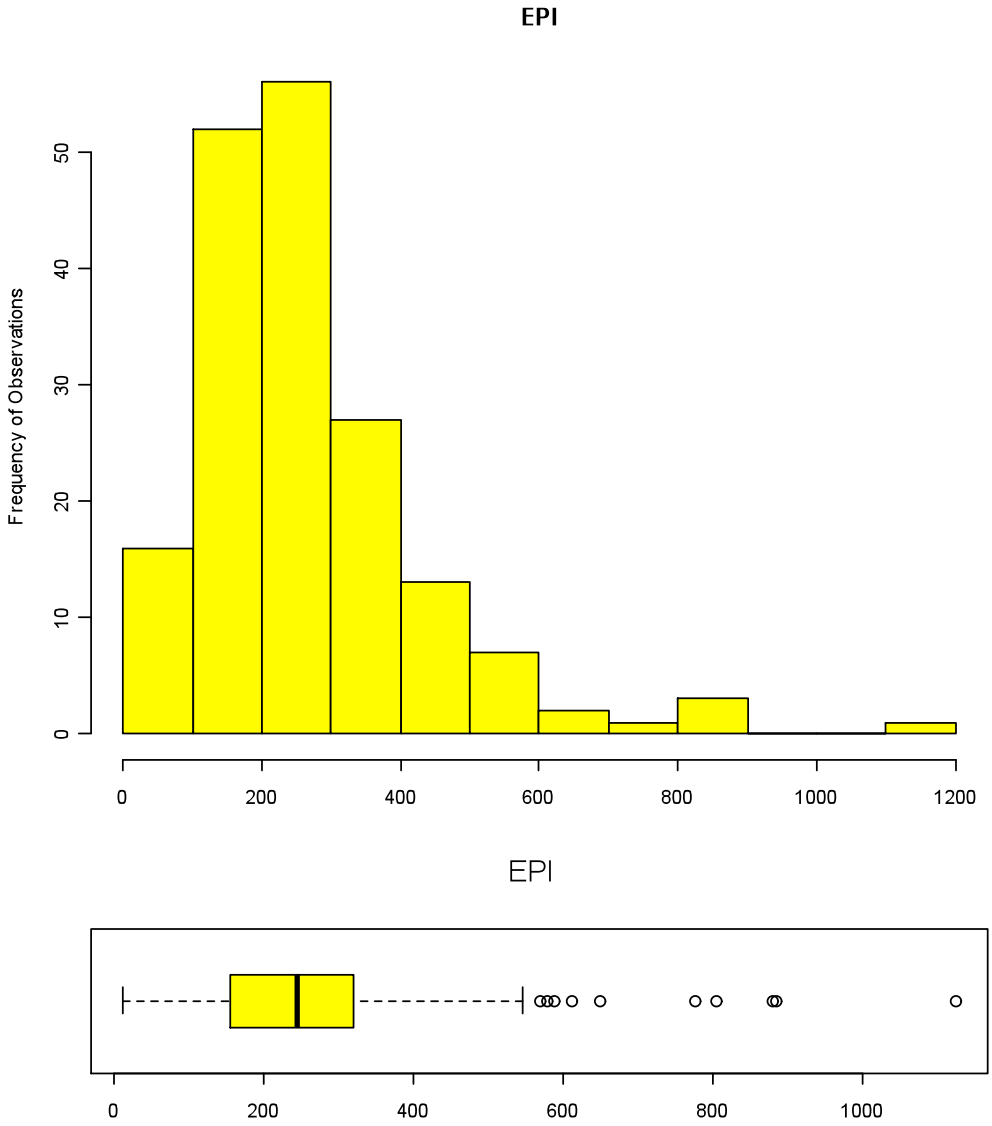


Figure 4-12

4.11.1. EPI of Luxury and Non Luxury Hotels

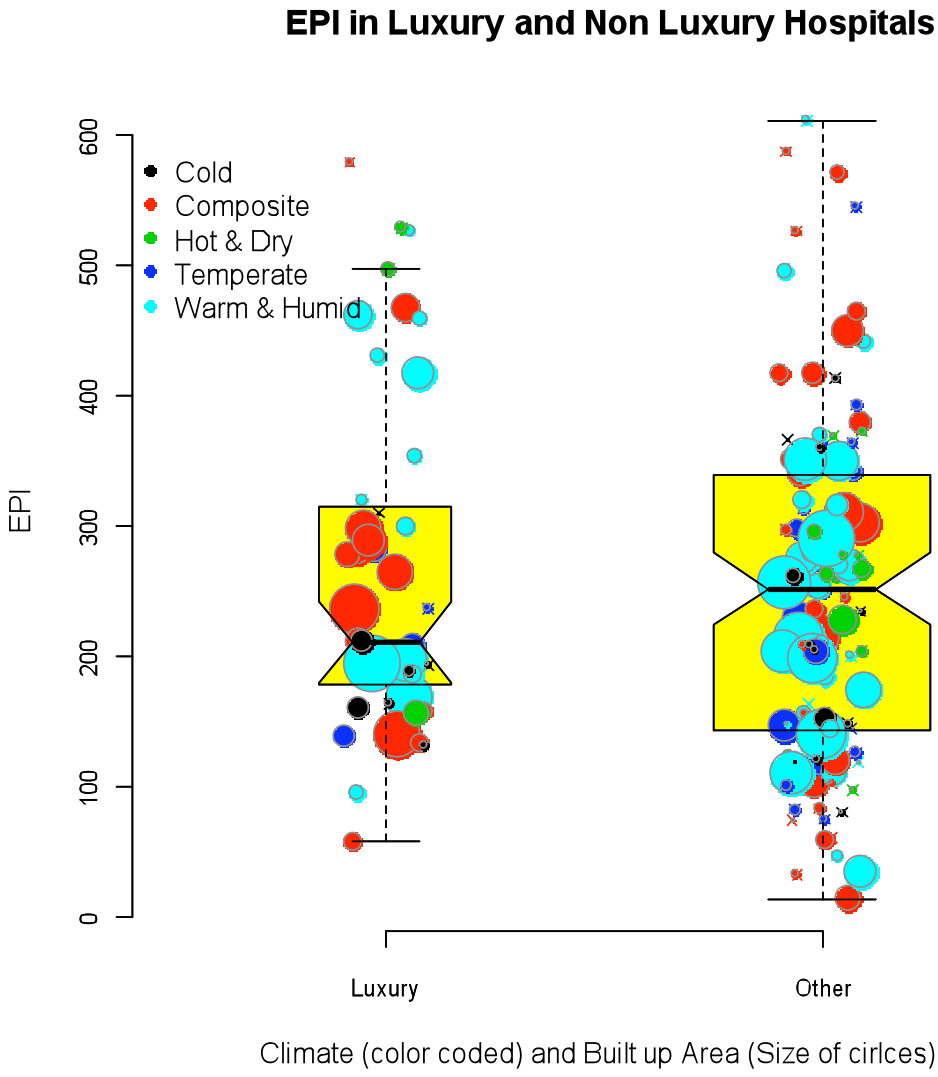


Figure 4-13

EPI of Luxury and Non Luxury Hotels

	count	sum	mean	median	sd	min	max
1 Luxury	48	13161	274.2	211.0	154.0	57.76	878.9
2 Other	130	34656	266.6	251.8	171.9	13.22	1123.0

Table 4-7

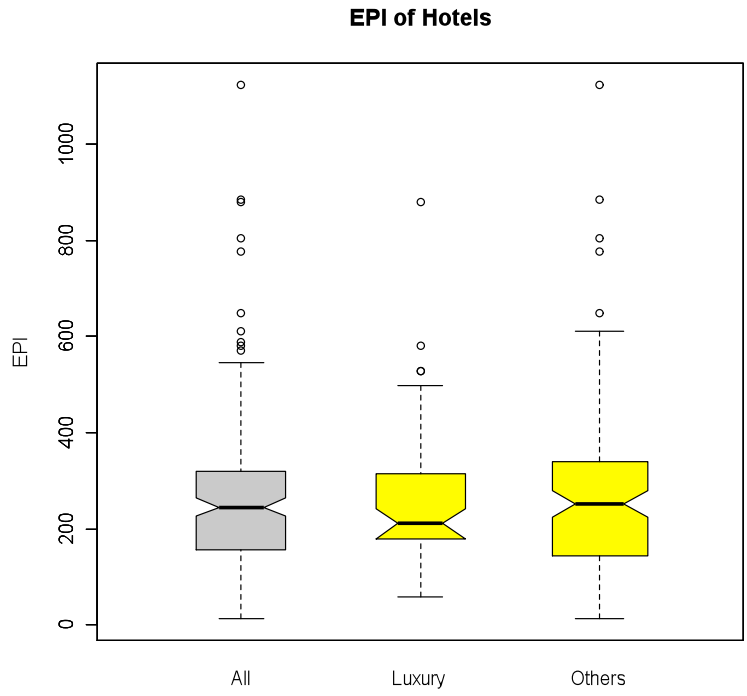


Figure 4-14

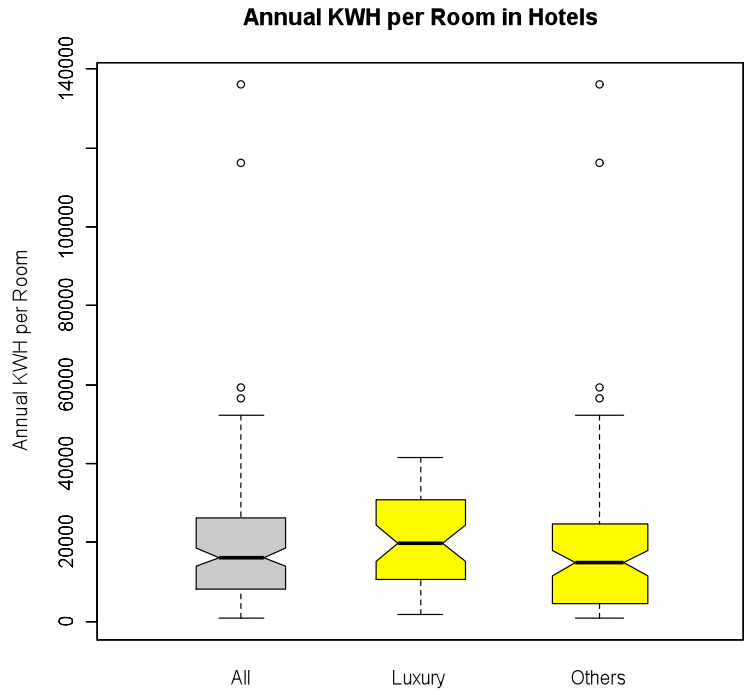


Figure 4-15

4.11.2. EPI and Climate

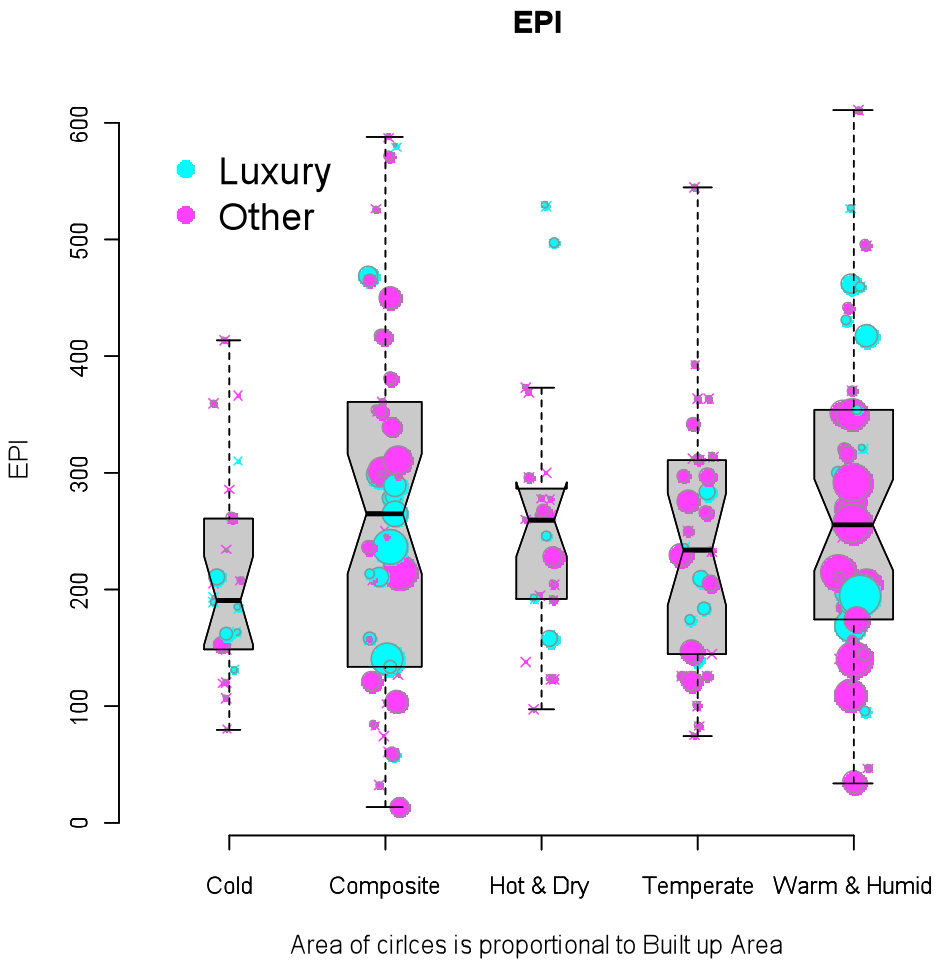


Figure 4-16

		count	sum	mean	median	sd	min	max
1	Cold	22	4601	209.1	190.8	90.1	80.0	413.3
2	Composite	49	14132	288.4	264.7	208.3	13.2	1123.0
3	Hot & Dry	23	5864	255.0	260.0	109.5	97.2	528.7
4	Temperate	30	7134	237.8	234.1	107.4	74.5	545.5
5	Warm & Humid	54	16086	297.9	255.2	189.3	33.8	884.4

		count	sum	mean	median	sd	min	max
Cold	Luxury	8	1542	192.7	186.0	53.2	131.4	310.1
Composite	Luxury	14	3599	257.1	250.6	134.6	57.7	579.5
Hot & Dry	Luxury	5	1620	324.0	245.3	175.5	156.8	528.7
Temperate	Luxury	6	1224	203.9	196.0	50.6	139.0	282.8
Warm & Humid	Luxury	15	5177	345.1	320.1	197.8	94.2	878.9
Cold	Other	14	3060	218.5	206.1	106.4	80.0	413.3
Composite	Other	35	10532	300.9	297.0	231.8	13.2	1123.0
Hot & Dry	Other	18	4244	235.8	261.6	80.5	97.2	373.3
Temperate	Other	24	5910	246.3	257.3	116.6	74.5	545.5
Warm & Humid	Other	39	10910	279.7	253.7	185.3	33.8	884.4

Table 4-8:

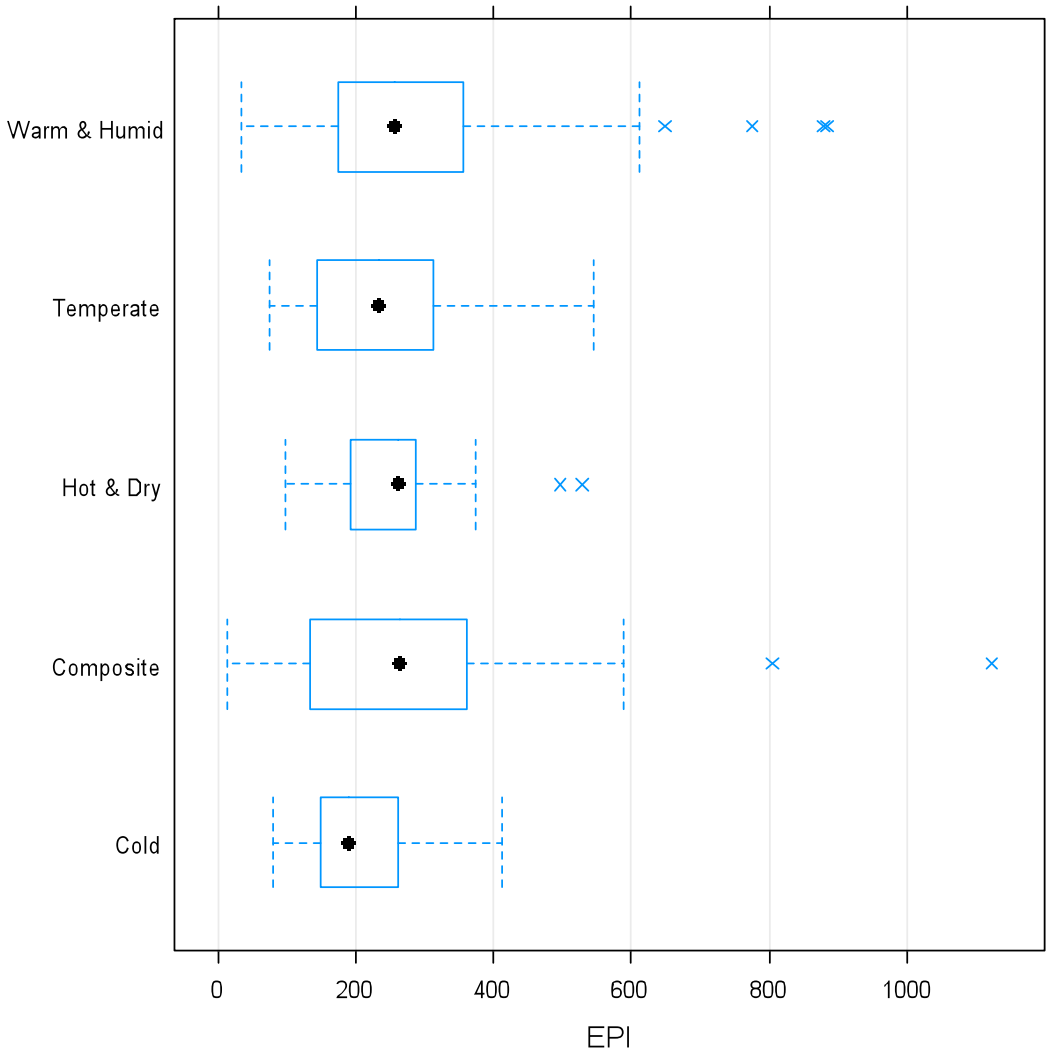

Warm & Humid
Temperate
Hot & Dry
Composite
Cold
0
200
400
600
800
1000
EPI

Figure 4-17

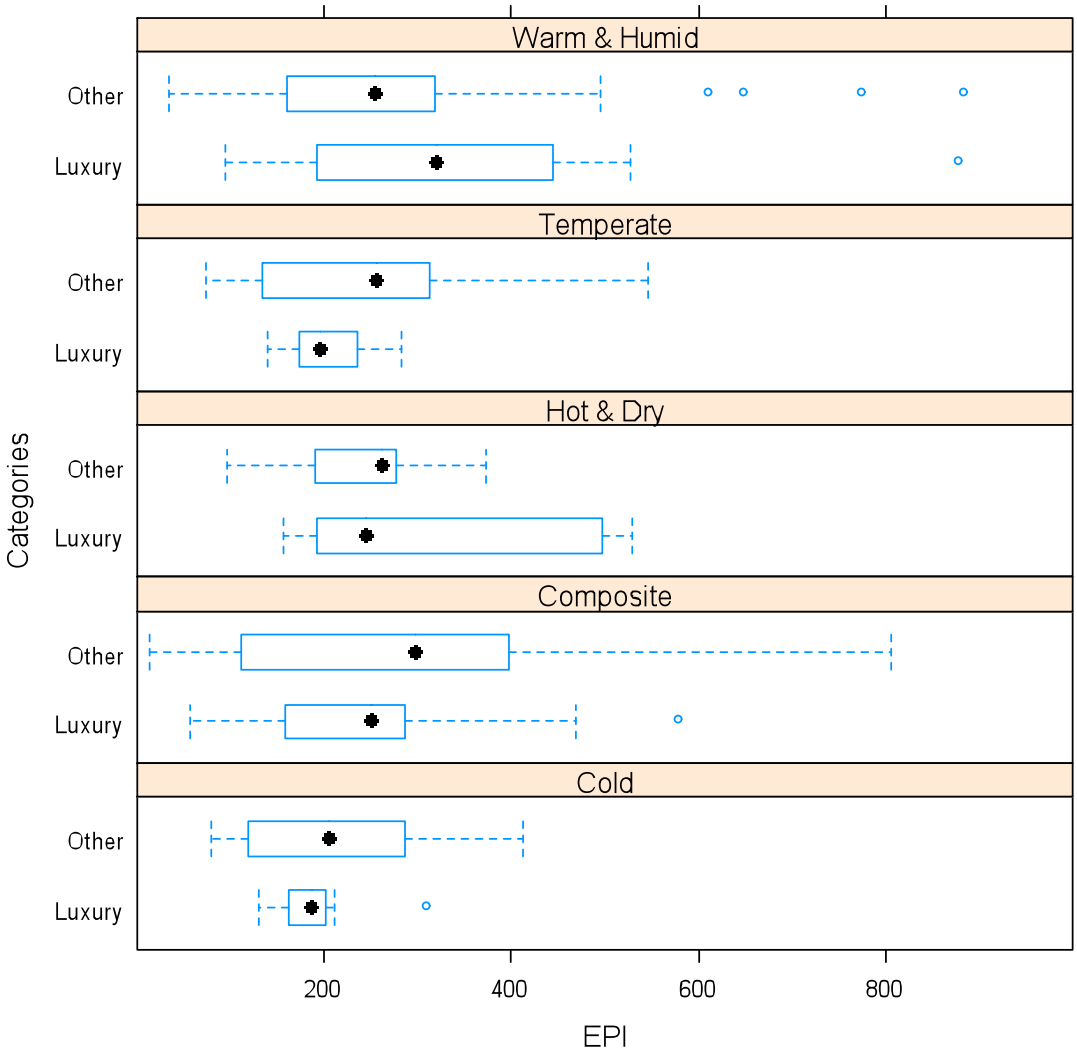


Figure 4-18: Hotels: EPI of different types across climate zones

4.12.Energy source characteristics

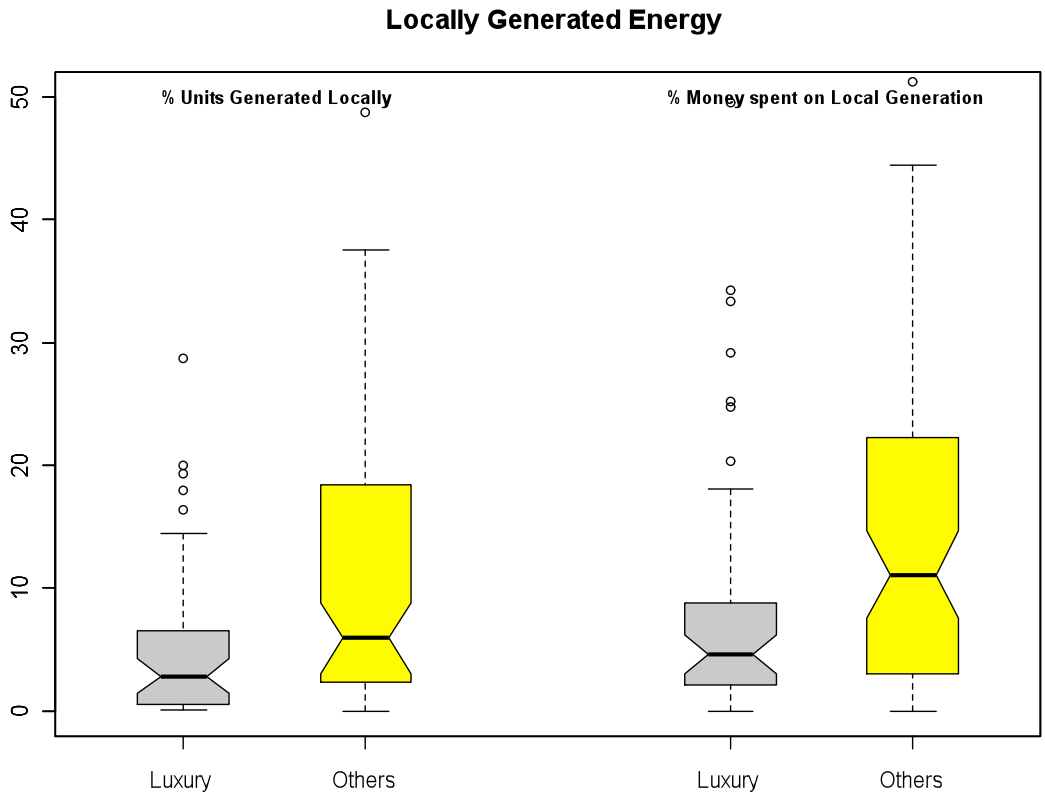


Figure 4-19

% Energy generated by DG / GG set (elec.dg*100/kwh)

	Group.1	count..	mean..	median..	sd..	min..	max.
1	Luxury	45	5.25	2.84	6.752	0.09	28.73
2	Other	77	12.33	5.95	15.059	0.00	100.00

% Energy Bill spend on DG / GG set generated power(elec.dg.cost*100/elec.cost)

	Group.1	count..	mean..	median..	sd..	min..	max.
1	Luxury	45	9.82	4.66	12.85	0.00	53.82
2	Other	72	14.64	11.11	13.46	0.00	51.24

Table 4-9:

The dependency of Non luxury hotels on locally generated power is almost double that of the dependency of luxury hotels both in terms of percentage amount generated and percent money spent on locally generated electricity.

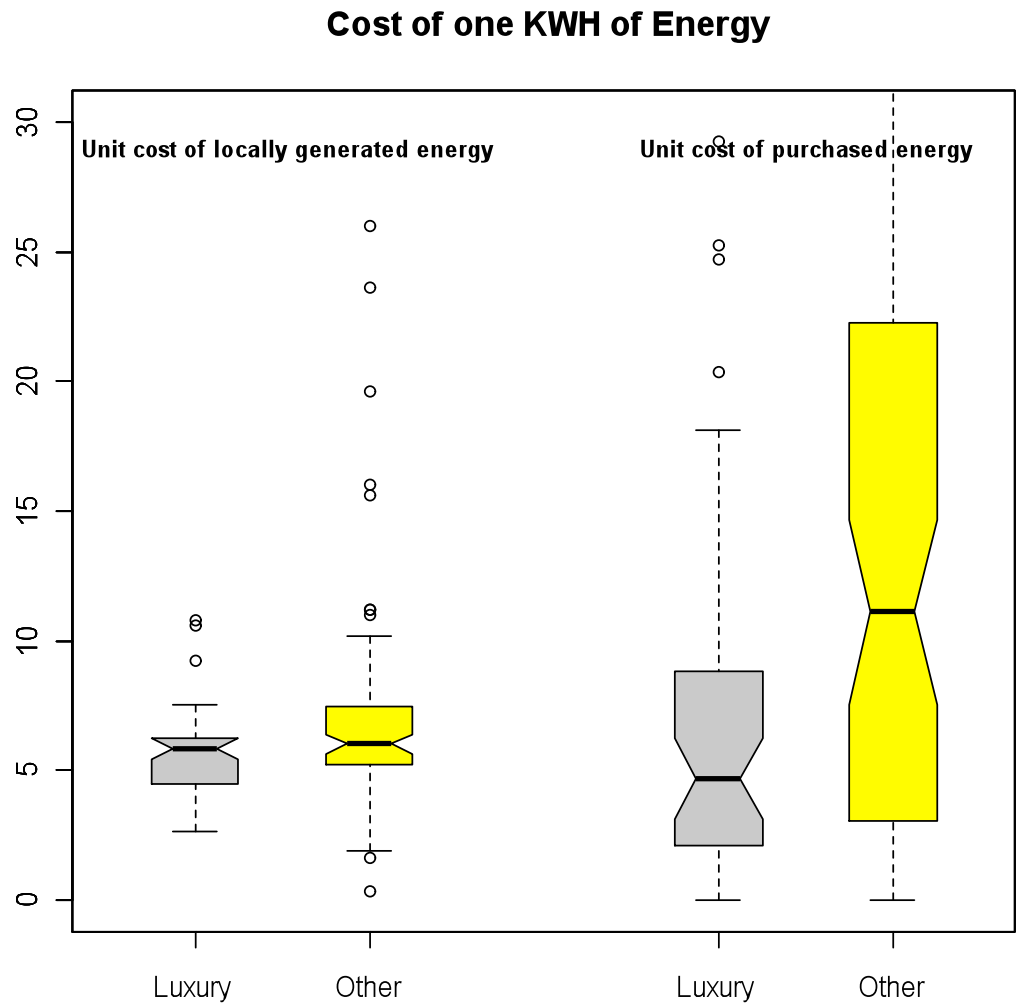


Figure 4-20

Unit Cost of Locally Generated Energy (elec.dg.cost/elec.dg)

	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	NA's
Large	2.671	4.508	5.815	6.923	6.246	55.390	3.000
Small	0.3422	5.1930	6.0000	7.5720	7.3670	40.0000	15.0000

Unit Cost of Purchased Energy (elec.pur.cost/elec.pur)

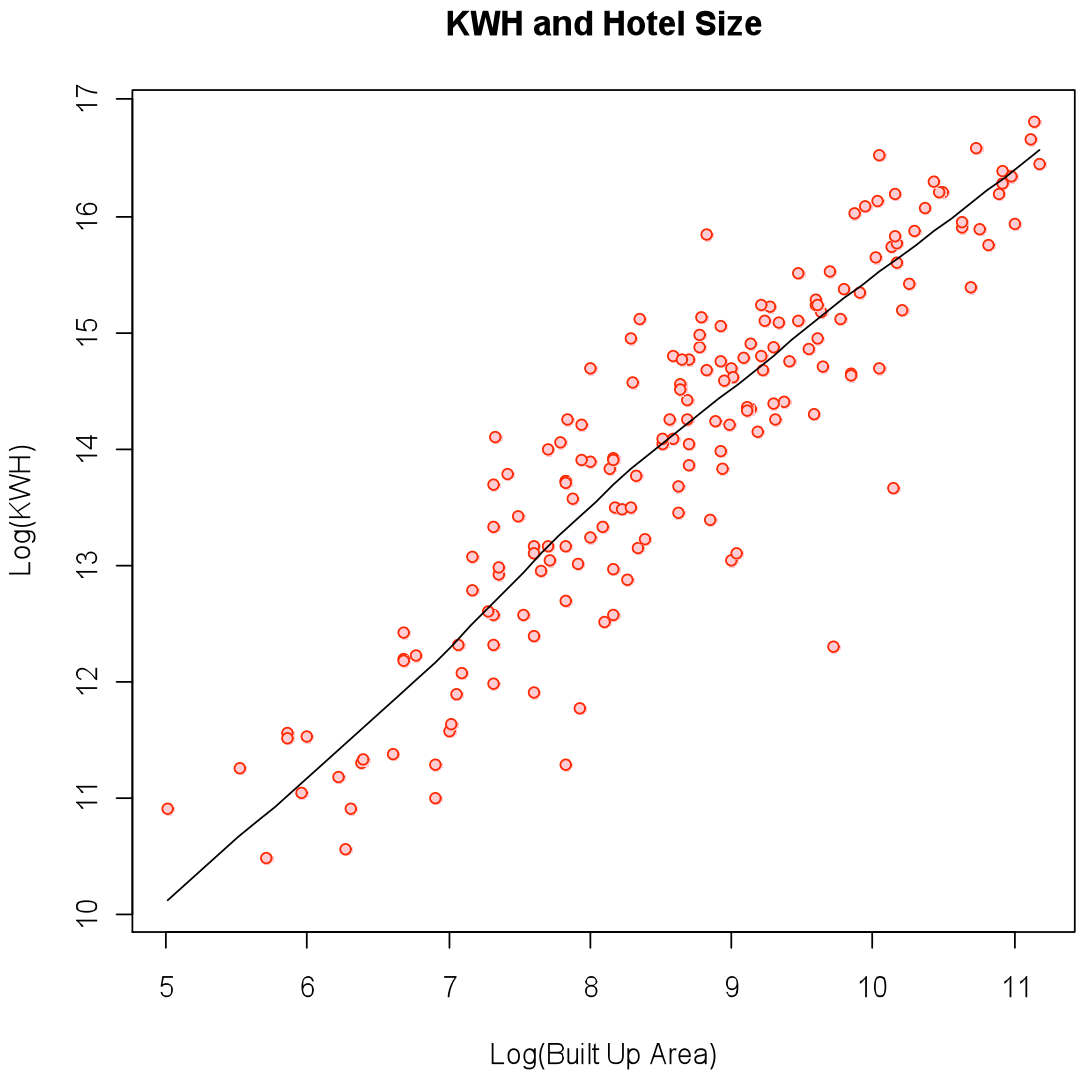
	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	NA's
Large	0.00	2.10	4.66	9.82	8.82	53.82	3.00

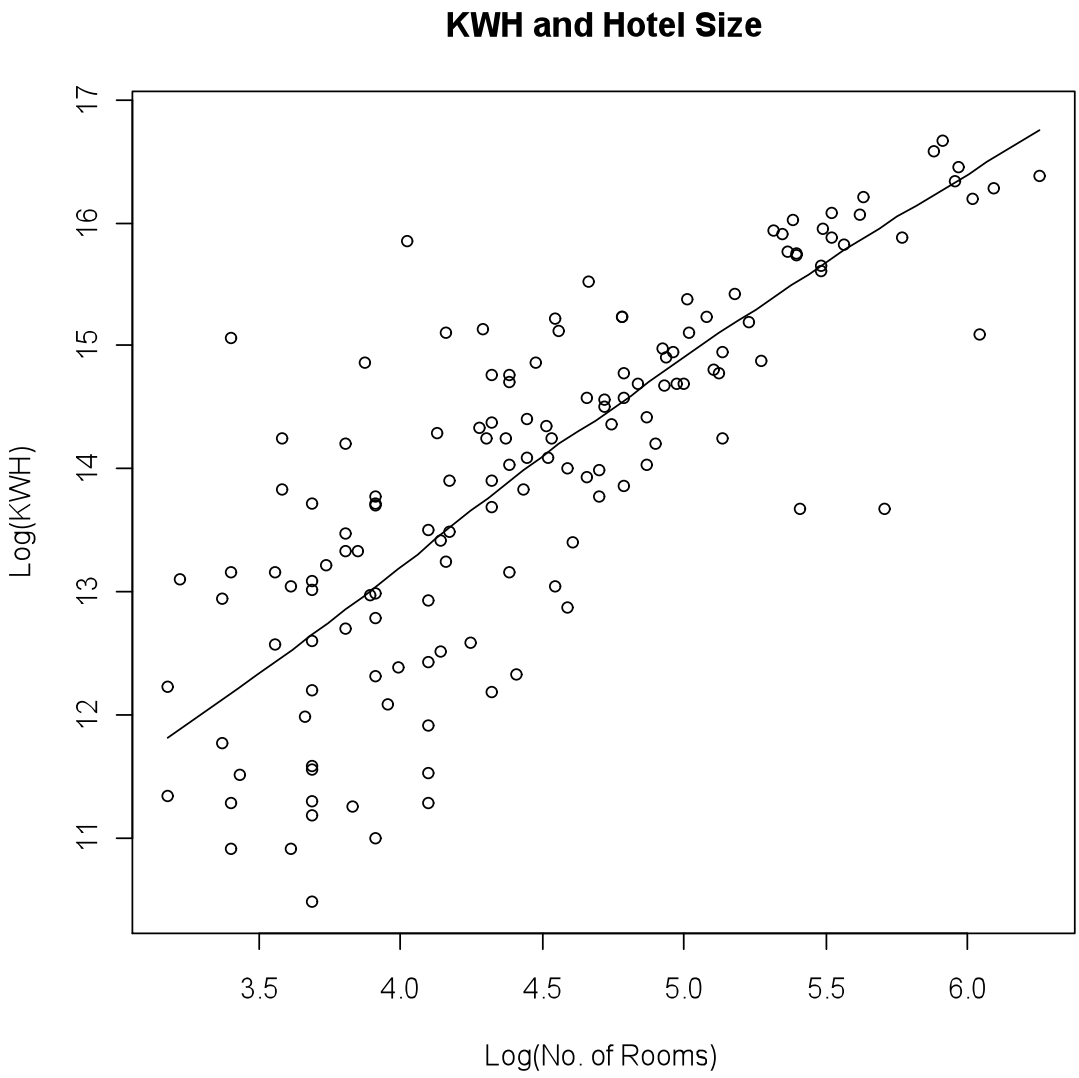
Small	0.00	3.11	11.11	14.65	22.05	51.24	64.00

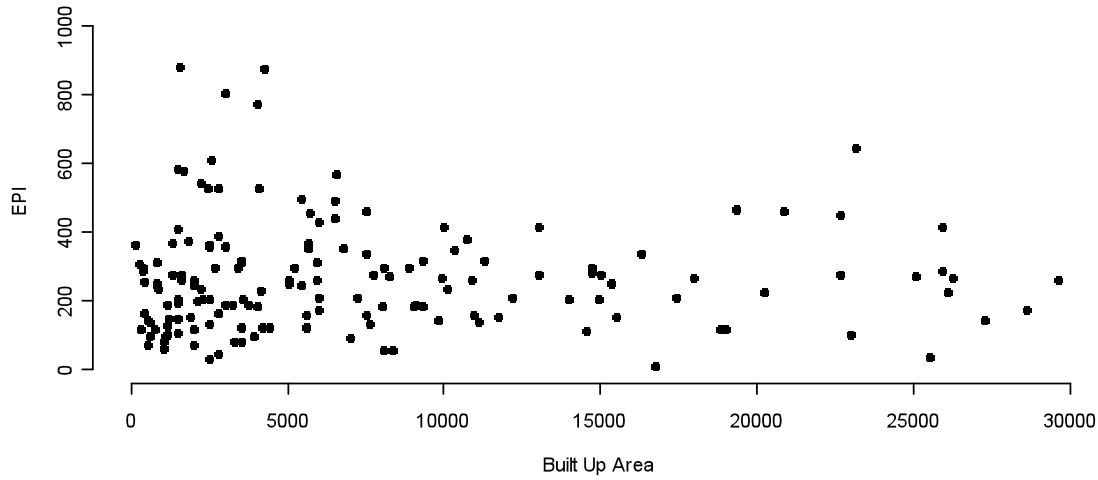
Table 4-10:

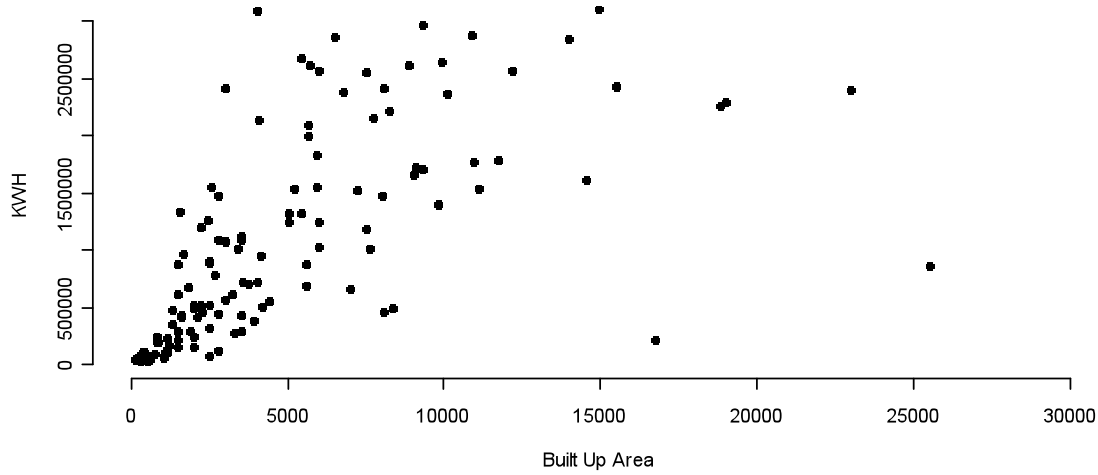
The unit cost of electricity purchased by non luxury hotels is about 50% higher than that of the unit cost paid by luxury hotels. The reason behind this needs further investigation.

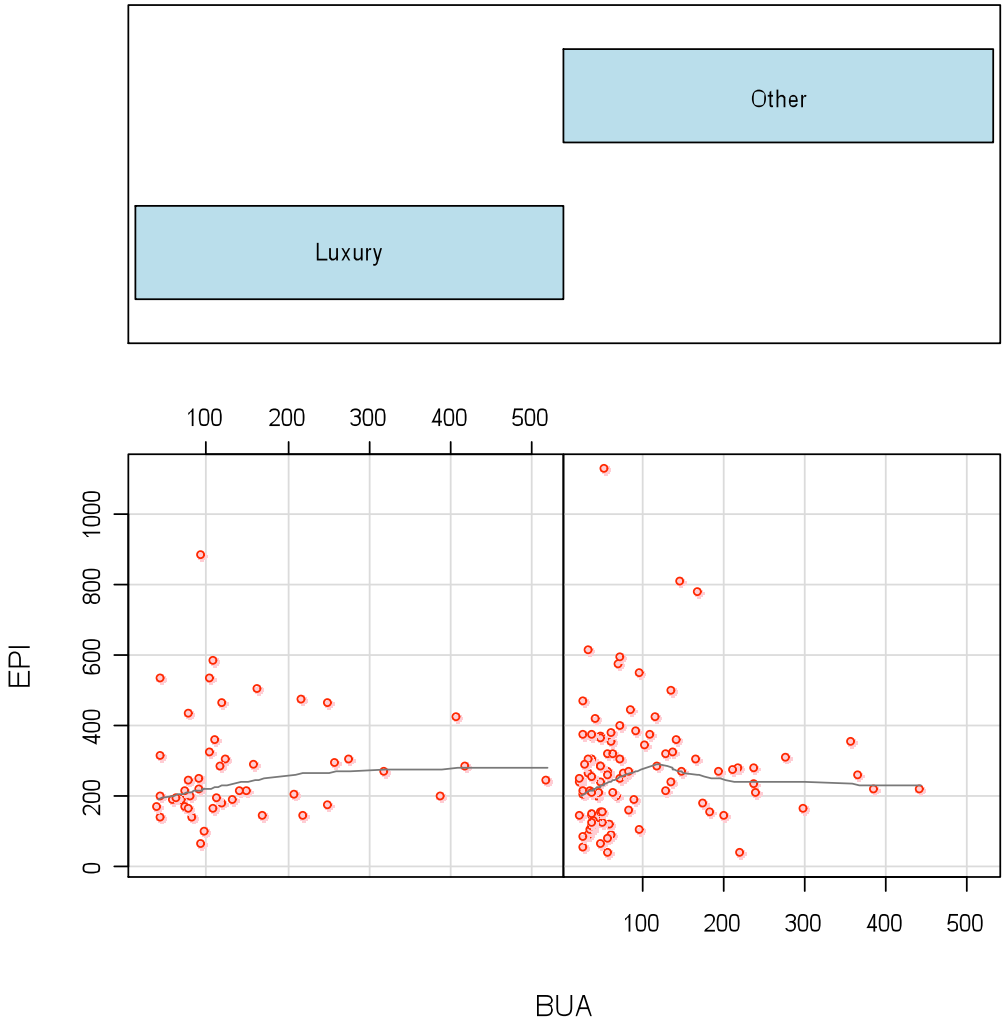
4.13.Electricity Consumption and Hotel Size




KWH and Hotel Size
Log(KWH)
11
12
13
14
15
16
17
3.5
4.0
4.5
5.0
5.5
6.0
Log(No. of Rooms)


EPI
0
200
400
600
800
1000
0
5000
10000
15000
20000
25000
30000
Built Up Area


KWH
0
500000
1500000
2500000
0
5000
10000
15000
20000
25000
30000
Built Up Area


Other
Luxury
100
200
300
400
500
EPI
0
200
400
600
800
1000
100
200
300
400
500
BUA

5.Cross sector analysis

Sample	Median	epi	kwh	bua	hrs.day	emp	pac2	empden
1	Hospital	289.95	1484850	4500	24	150	0.60	0.04840
2	Hotel	245.23	1475737	5797	24	130	0.80	0.03042
3	Office	172.13	1401495	7466	10	531	0.75	0.08613

Table 5-1:

5.1. EPI and KWH

	obs.	mean	median	s.d.	min.	max.
Hospital	142	318.7	289.9	188.383	20.12	865
Hotel	174	271.1	245.2	167.572	13.22	1123
Office	286	218.4	172.1	162.069	18.97	890

Table 5-2:

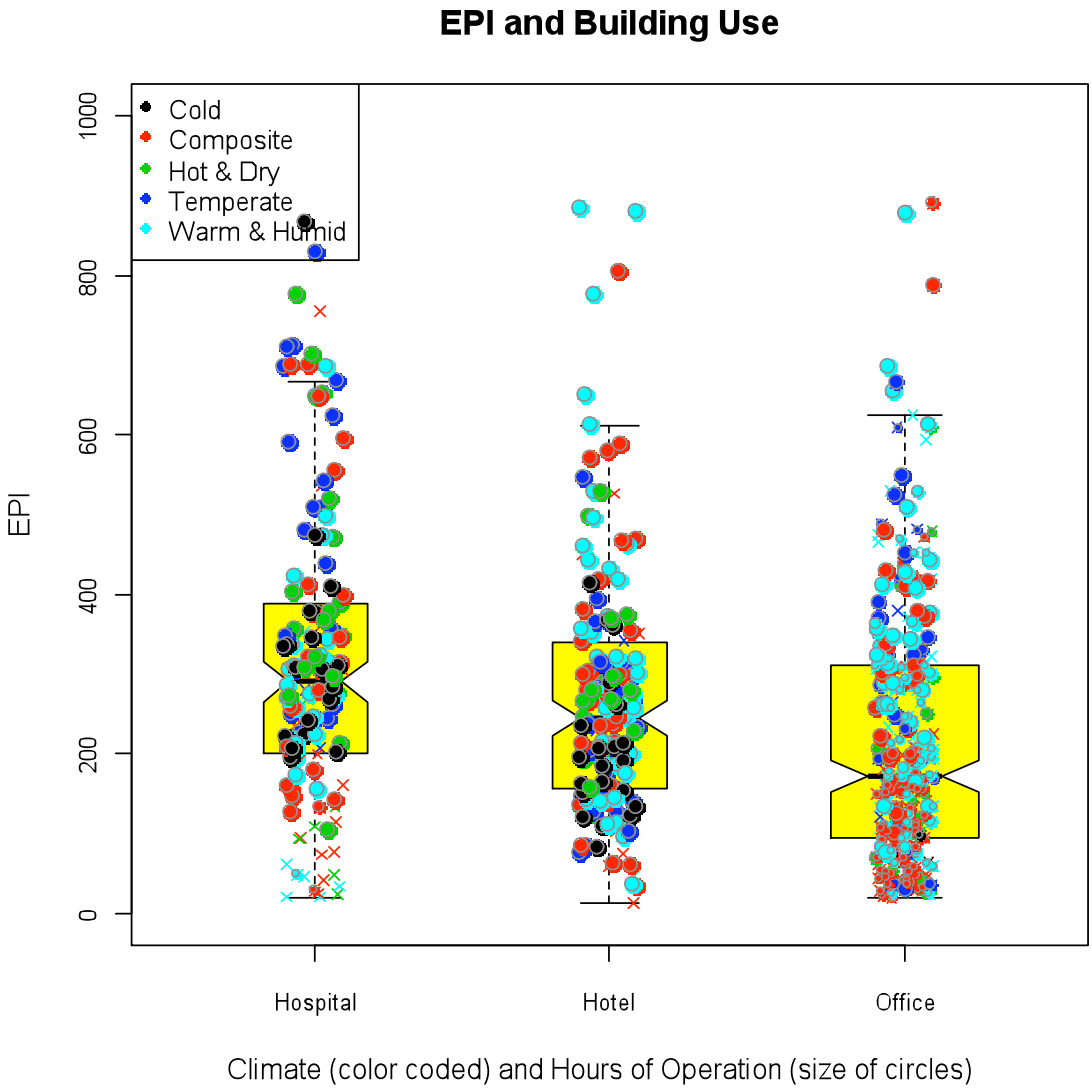


Figure 5-1

EPI of Hospitals is significantly greater than that of Hotels, followed by Offices

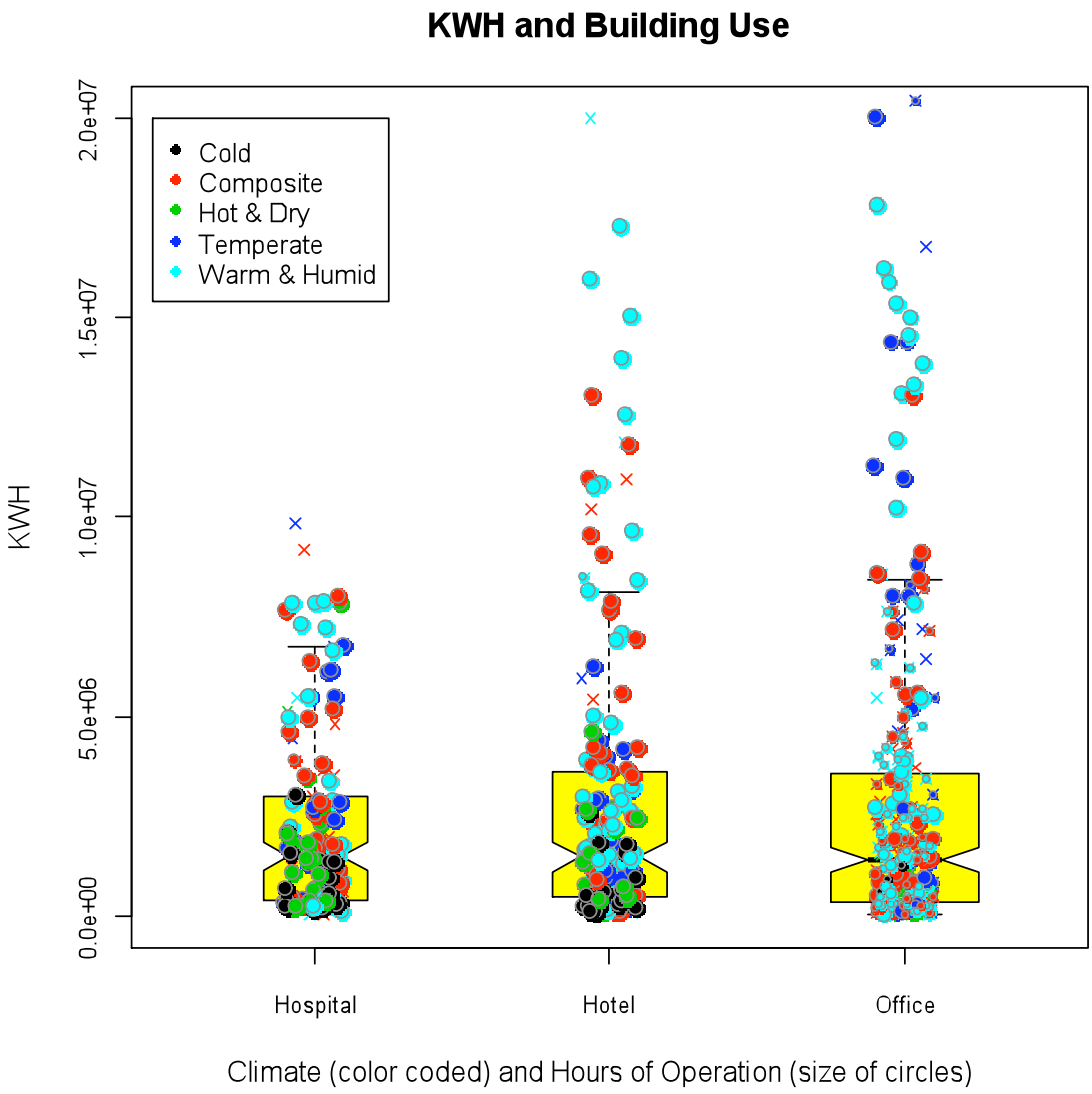


Figure 5-2

The variation in energy total consumption is larger in offices and Hotels

5.2. EPI and BUA

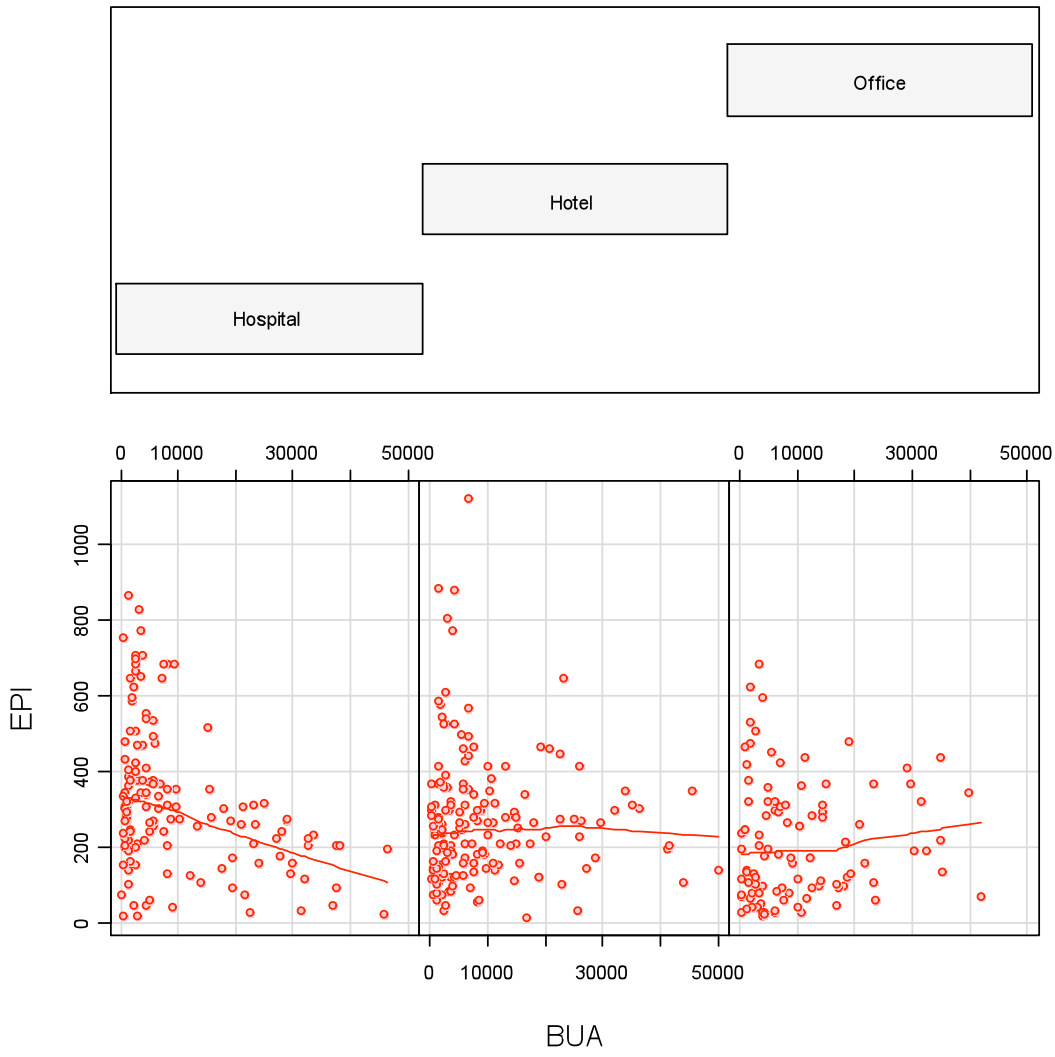


Figure 5-3

All Hospital, Hotels and conditioned Office buildings and area<50,000 sq mt,

Hospitals: EPI seems to decrease with increase in BUA

Hotel: EPI seems to be invariant to BUA

Offices: EPI seems to increase with increase in BUA

5.3. EPI in different climatic zones

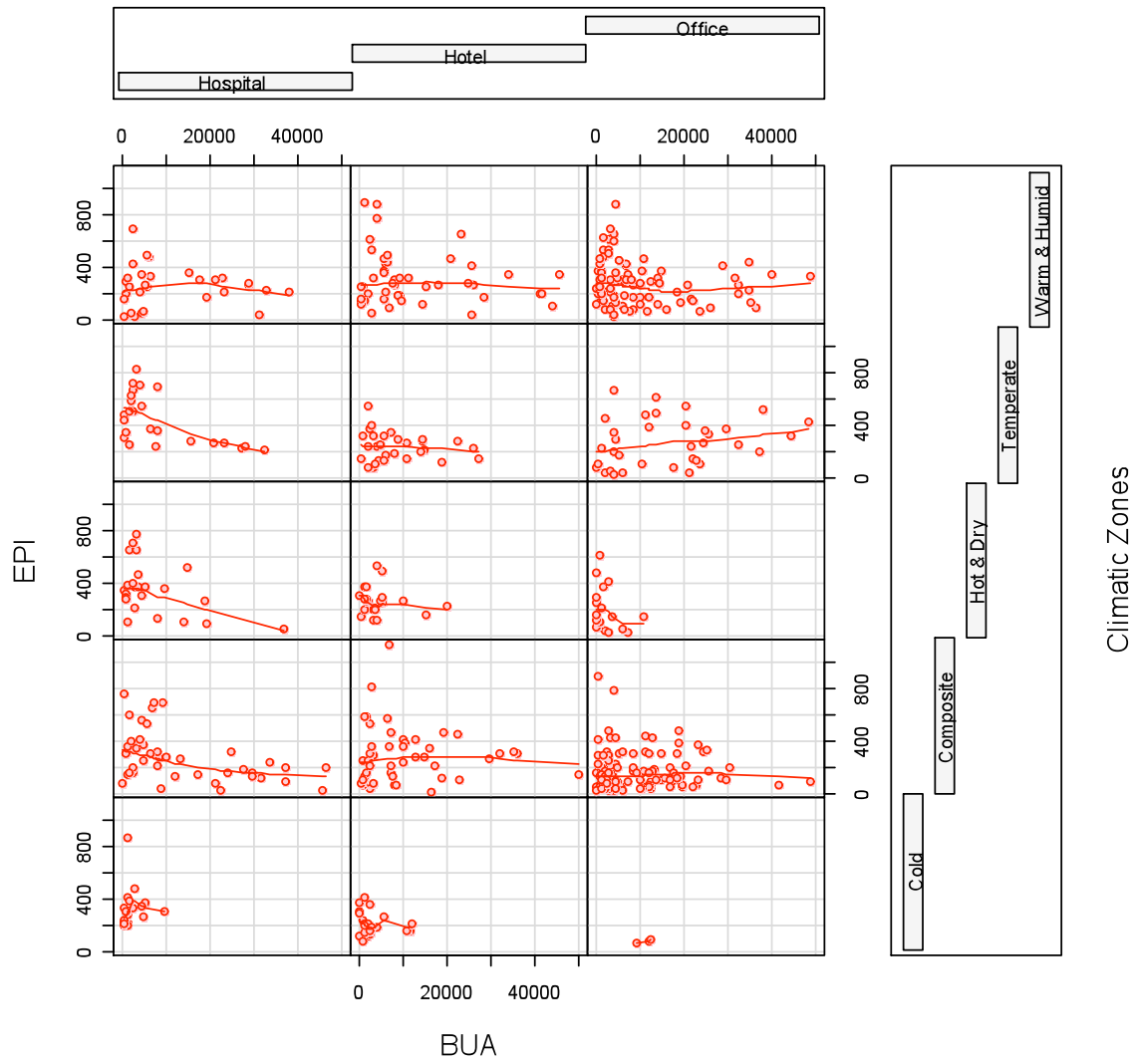


Figure 5-4

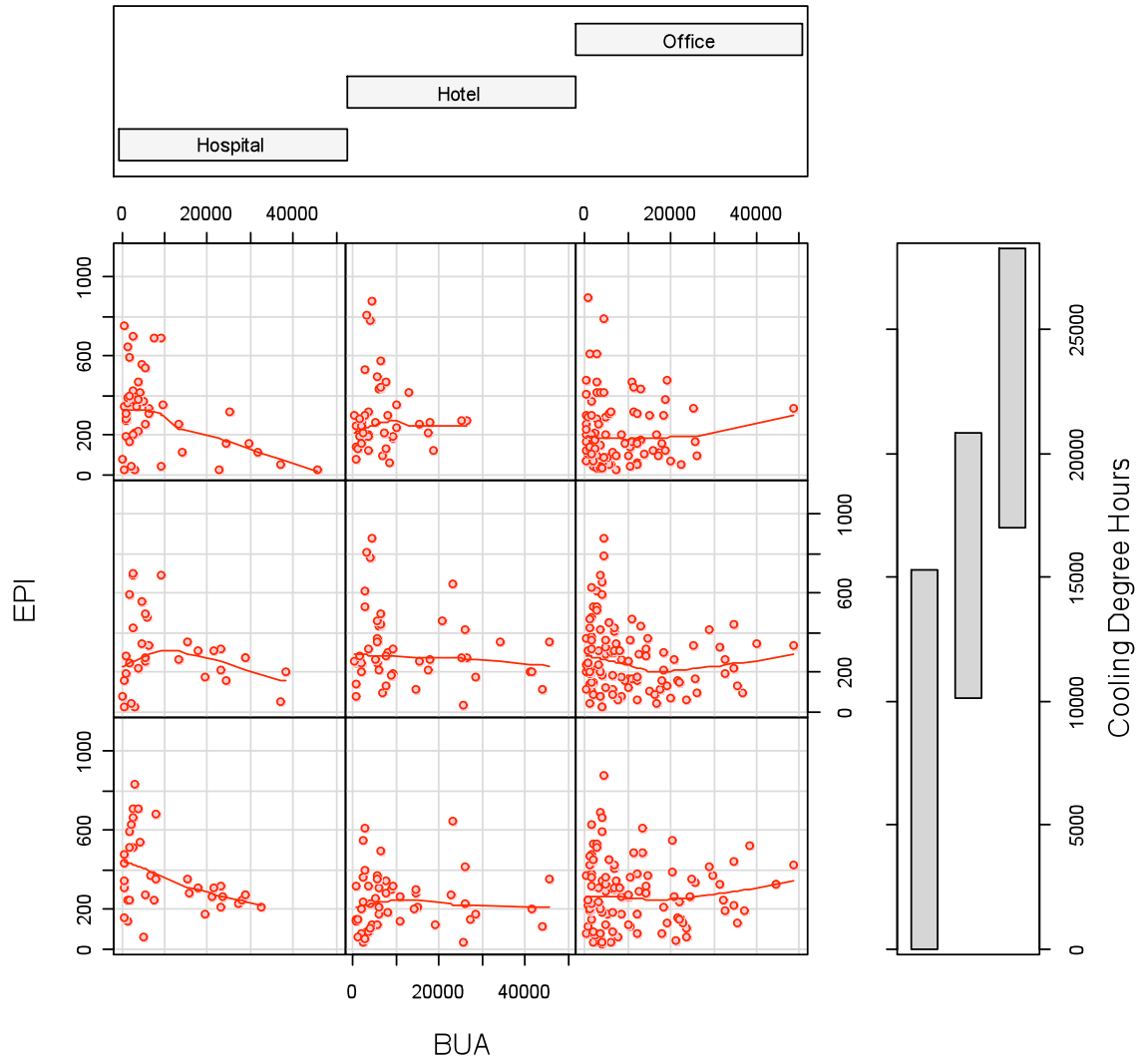

Office
Hotel
Hospital
0
20000
40000
0
200
600
1000
EPI
BUA
Cooling Degree Hours
0
5000
10000
15000
20000
25000

Figure 5-5

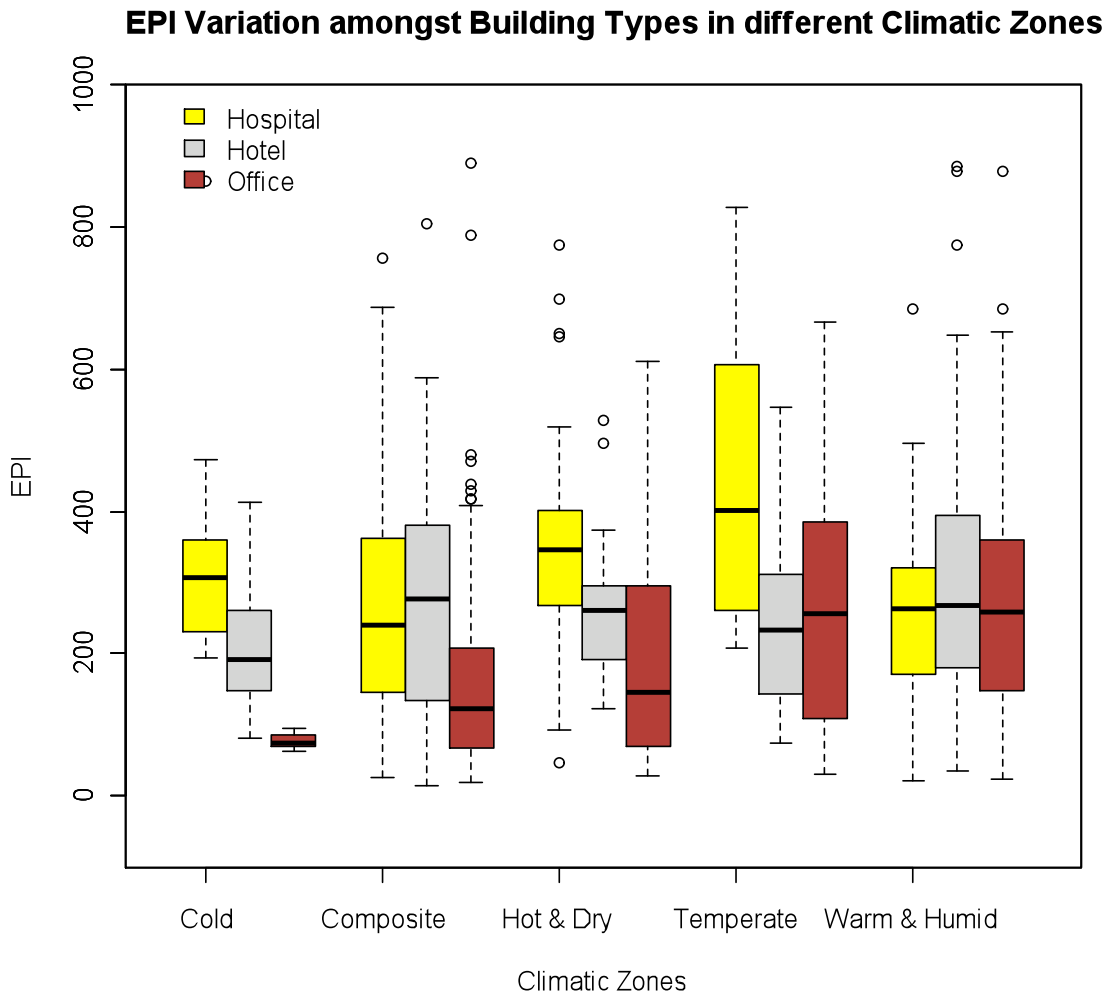


Figure 5-6

Why do hospitals have such a high EPI in Temperate zone?

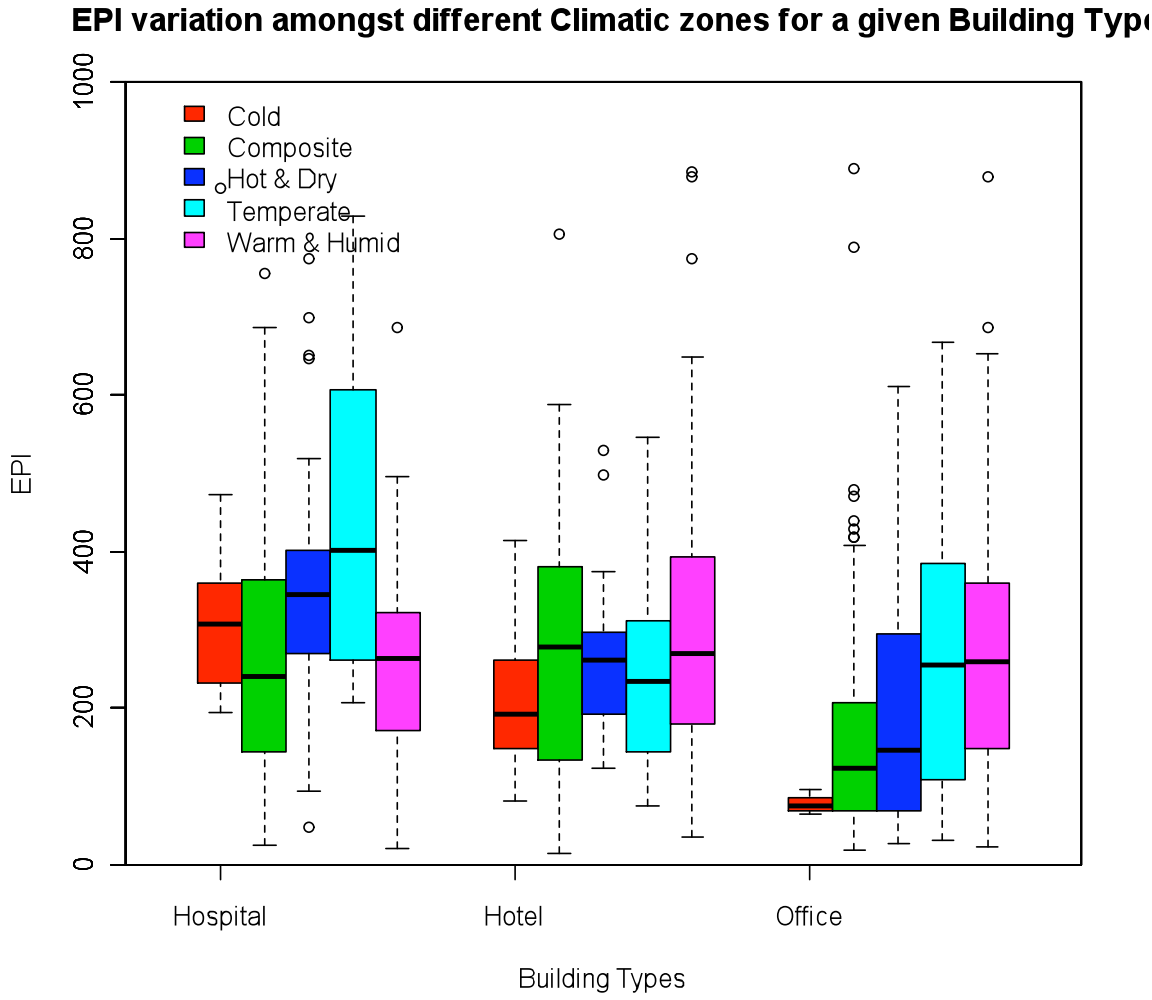

EPI variation amongst different Climatic zones for a given Building Type
Cold
Composite
Hot & Dry
Temperate
Warm & Humid
EPI
0
200
400
600
800
1000
Hospital
Hotel
Office
Building Types

Figure 5-7

5.4. EPI and % Conditioned Space

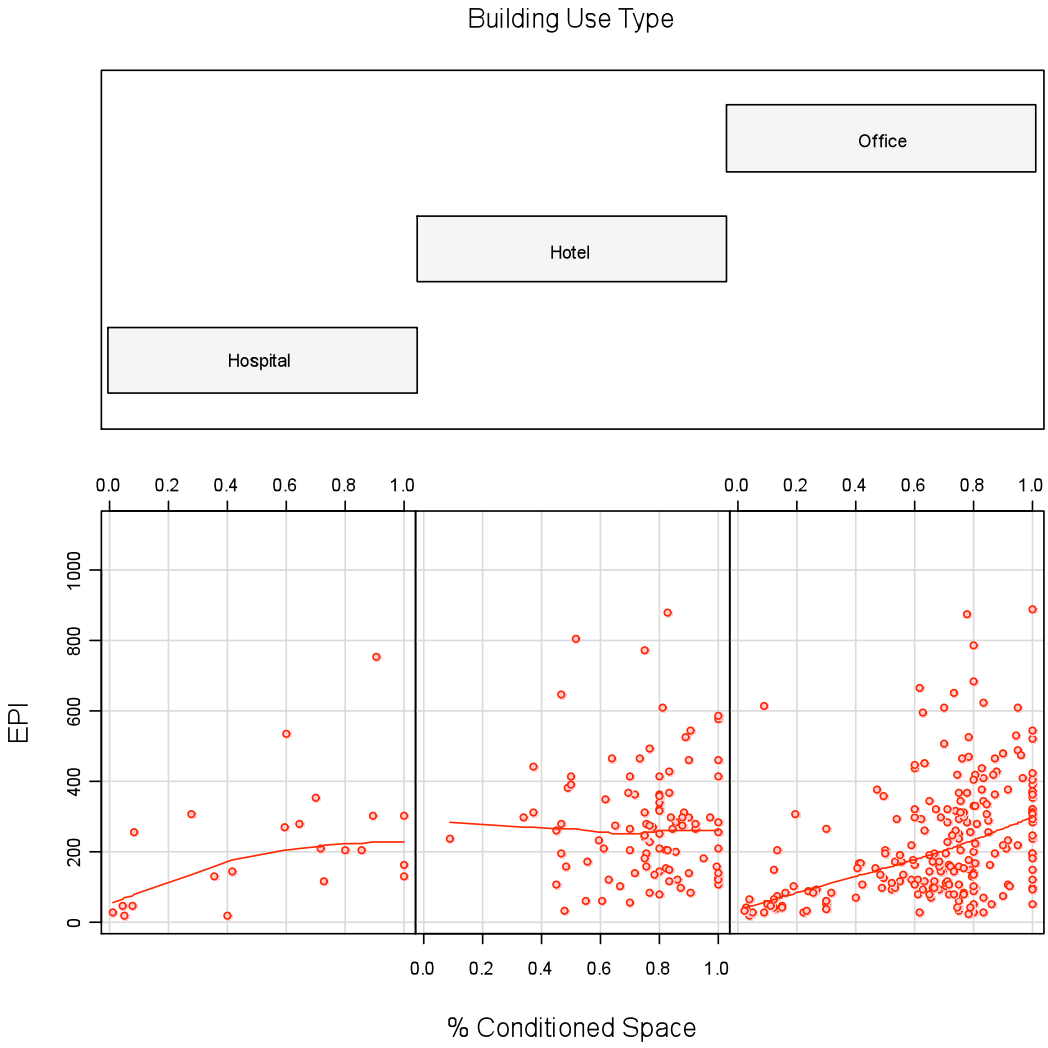


Figure 5-8

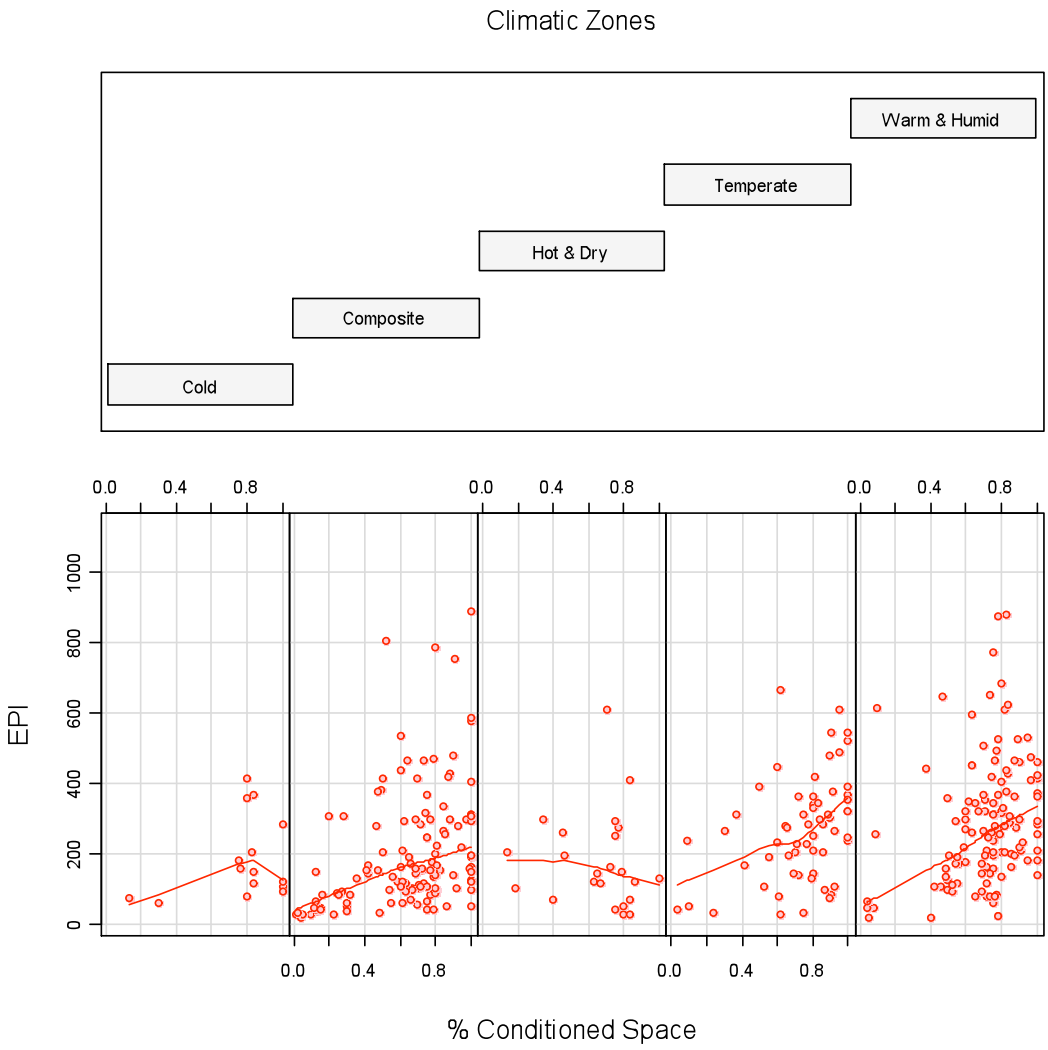

Climatic Zones
Warm & Humid
Temperate
Hot & Dry
Composite
Cold
EPI
0
200
400
600
800
1000
0.0
0.4
0.8
% Conditioned Space

Figure 5-9

USAID ECO-III Project
AADI Building, (Lower Ground Floor)
2 Balbir Saxena Marg, Hauz Khas, New Delhi - 110 016
Tel: +91-11-45974597; Fax: +91-11-26853114
Email: eco3@irgssa.com; Website: www.eco3.org