

Analysis of comfort survey data

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1 Rationale

Some offices in the building are often too hot, particularly in Summer, and some are too cold in Winter. Generally, the temperature increases higher up the building, but the readings from the Building Energy Management Sensors (BEMS) on a winter morning at 8am show that even on Level 5 there are rooms around 14°C.

At Building Committee in December, Dougie Williams had the idea that we could try to increase the ventilation air flow to offices that are too hot and reduce it to offices that are too cold. This can be done by adjusting the flow rate through, and in some cases sealing off entirely, the ventilation grilles in certain offices. The intended effect of this change would be to improve working conditions, and it should also increase the flow rate to areas where the dampers do not currently get closed at night. This might cause these areas to be cooled enough throughout the day so that the dampers close at night.

In order to target these changes most effectively, we decided that we should find out exactly where in the building people perceived themselves to be too hot or cold, and so we ran a web-based “comfort survey”¹. This also asked questions about whether people use their windows and doors to control the temperature. Whether people do this may depend on external and internal noise levels; for example during the Fringe, there is a lot of noise BBC tent and area behind the Forum. This is the initial analysis of results from the Comfort survey.

2 The survey & data

The full list of questions is in Appendix A.1.

There were 106 respondents. Given about 500 occupants of the Fourm, this is about a 20% response rate.

As there are some multiple-occupancy offices, there were respondents from 81 offices. To find out how the various levels of the Forum are represented, we create a column that shows the level of a respondent:

1	2	3	4	5	G
28	25	26	14	12	1

¹<http://comfortsurvey.inf.ed.ac.uk>

As might be expected, levels 1–3 have more responses than levels G, 4 and 5.

It would also be interesting to know how many of the offices are internal or external.

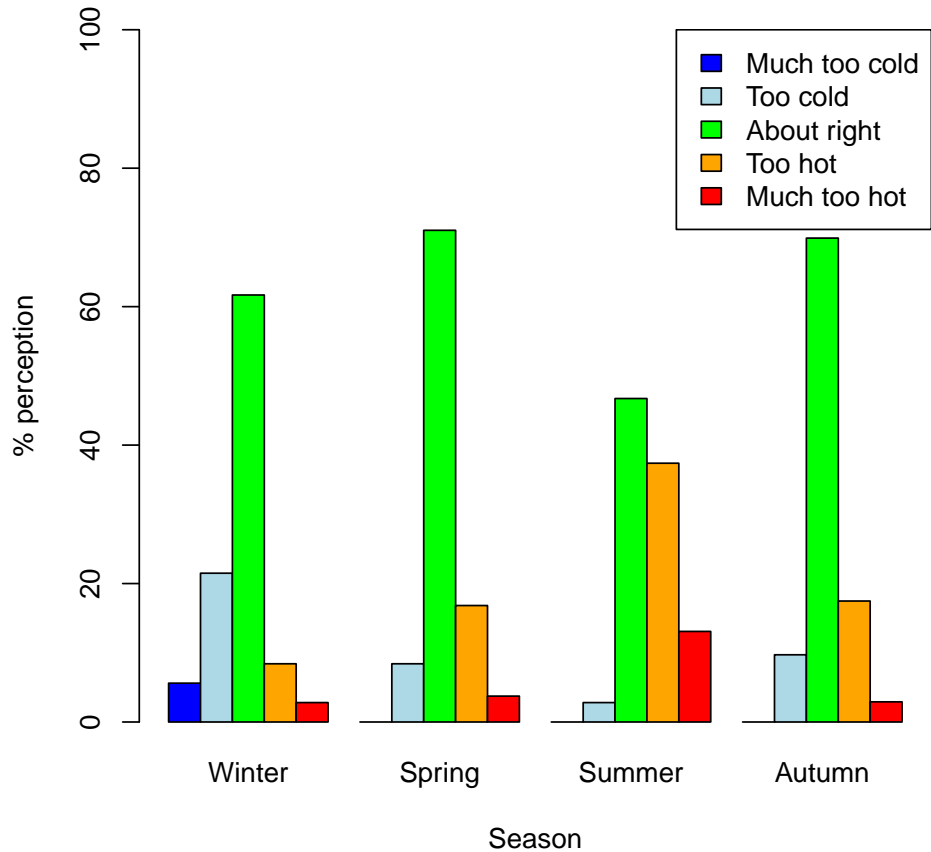
External	Internal
83	23

3 Temperature and air quality

3.1 Temperature by season

Here is the percentage of respondents' answers to the question "In <Season> do you tend to feel <Temperature>?"

Temperature	Season			
	Winter	Spring	Summer	Autumn
Much too cold	5.6	0.0	0.0	0.0
Too cold	21.5	8.4	2.8	9.7
About right	61.7	71.0	46.7	69.9
Too hot	8.4	16.8	37.4	17.5
Much too hot	2.8	3.7	13.1	2.9

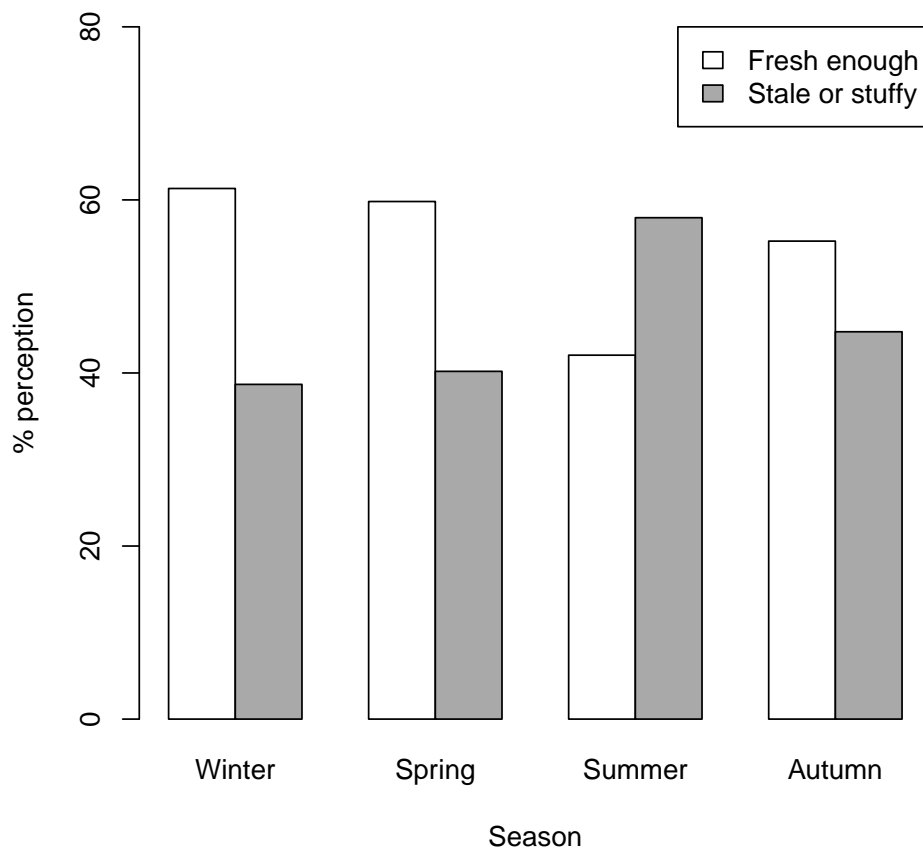


About 27% of respondents feel "Too cold" or "Much too cold" in the winter and about 51% of respondents feel "Too hot" or "Much too hot" in the summer.

3.2 Air quality by season

Here is the percentage of respondents' answers to the question "In <Season> does the air tend to feel (Fresh enough/Stale or stuffy)?":

Air	Season			
	Winter	Spring	Summer	Autumn
Fresh enough	61.3	59.8	42.1	55.2
Stale or stuffy	38.7	40.2	57.9	44.8



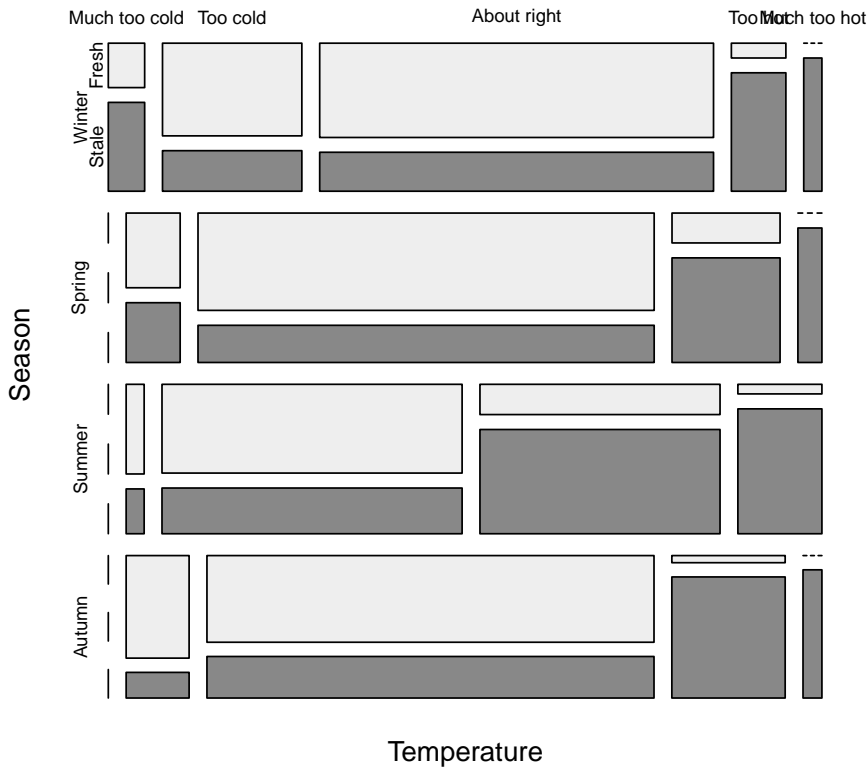
In summer, almost 60% of respondents felt the air was stale or stuffy; in winter this was still almost 40%.

3.3 Covariation of Air quality and Temperature

Does being stuffy have anything to do with a room being too hot? This suggests that stuffiness is associated with high perceived temperature. This table and plot suggest that stuffiness is associated with high perceived temperature.

		Temperature	Much too cold	Too cold	About right	Too hot	Much too hot
Season	Air						
Winter	Fresh enough		2	16	46	1	0
	Stale or stuffy		4	7	19	8	3
Spring	Fresh enough		0	5	55	4	0
	Stale or stuffy		0	4	21	14	4
Summer	Fresh enough		0	2	33	9	1
	Stale or stuffy		0	1	17	31	13
Autumn	Fresh enough		0	8	48	1	0
	Stale or stuffy		0	2	23	17	3

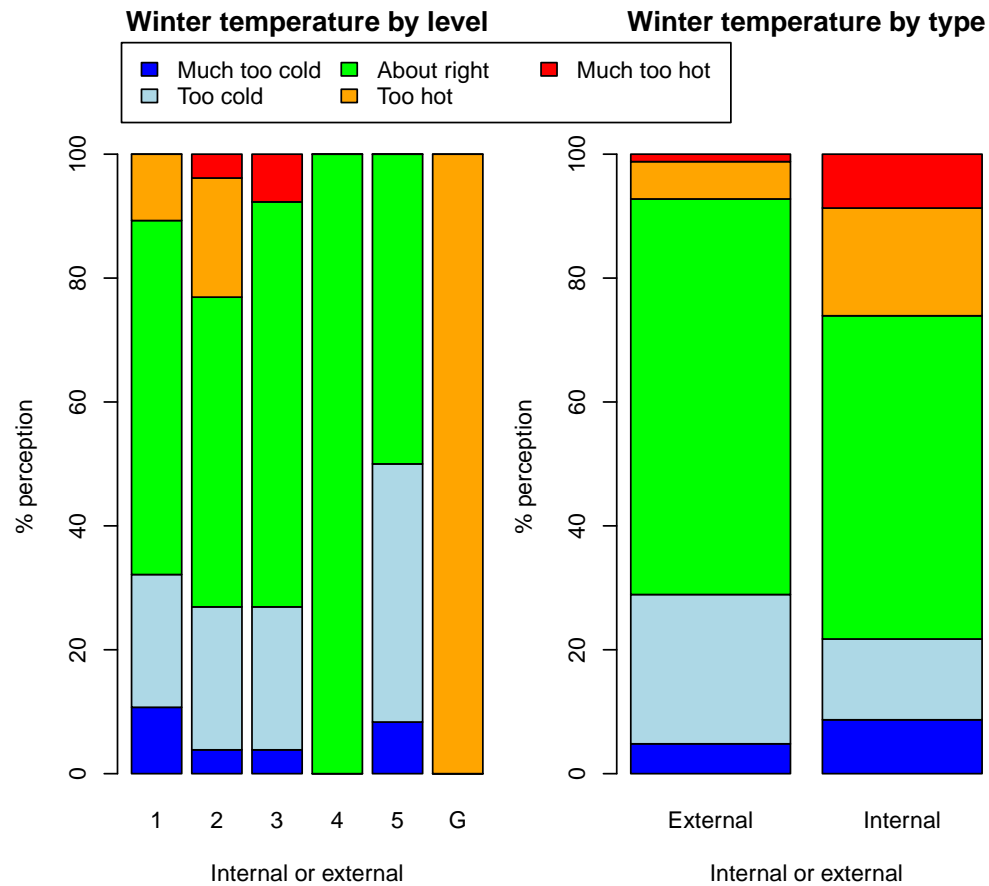
Temperature and air quality by season



3.4 Where are the cold offices?

In order to find out where the cold offices are, we looked at the winter perceptions. Apart from the absence of Level 4, the cold offices seem to be fairly evenly distributed, though with a bit of a bias towards Level 1. Looking at the list of cold offices, the Wolfson Wing on Level 1 seems particularly badly affected and corner offices are often cold.

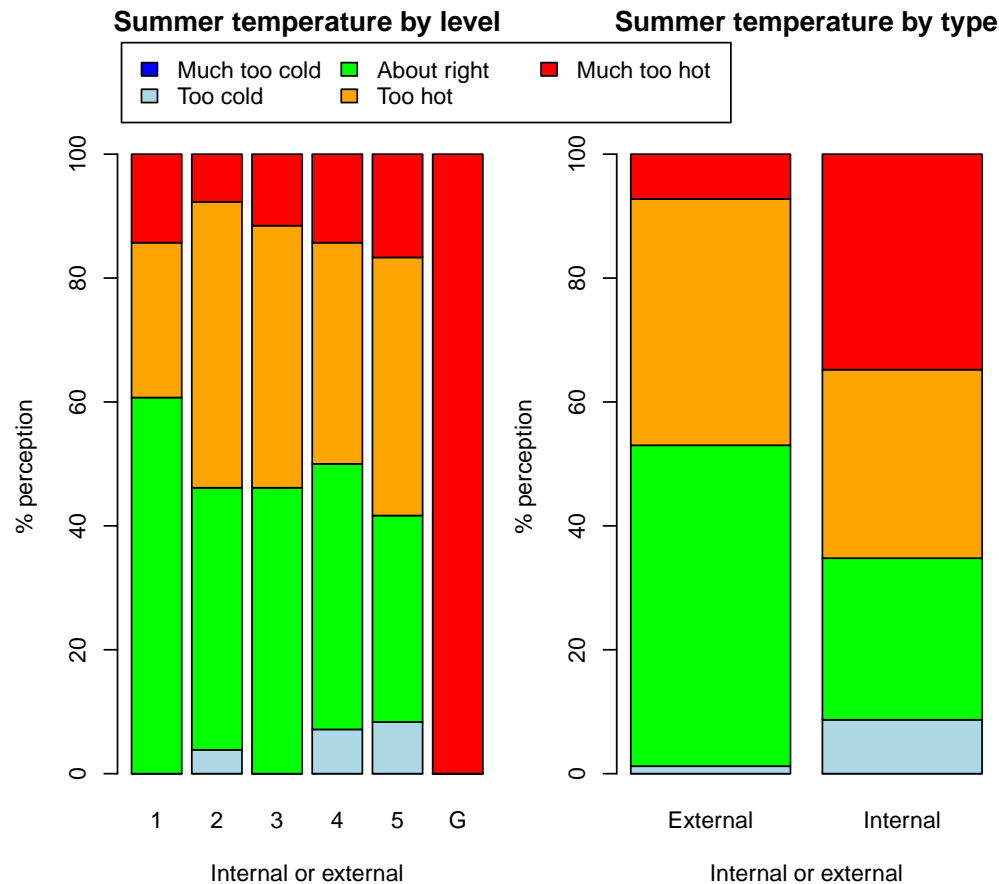
	level					
winter.temperature	1	2	3	4	5	G
Much too cold	10.7	3.8	3.8	0.0	8.3	0.0
Too cold	21.4	23.1	23.1	0.0	41.7	0.0
About right	57.1	50.0	65.4	100.0	50.0	0.0
Too hot	10.7	19.2	0.0	0.0	0.0	100.0
Much too hot	0.0	3.8	7.7	0.0	0.0	0.0



3.5 Where are the hot offices?

In order to find out where the hot offices are, we looked at the summer temperature. The hot offices seem to be fairly evenly distributed between the levels. (Note that there was only one 1 respondent on the Ground level.) Internal offices seem much more likely to suffer from extreme heat than external ones.

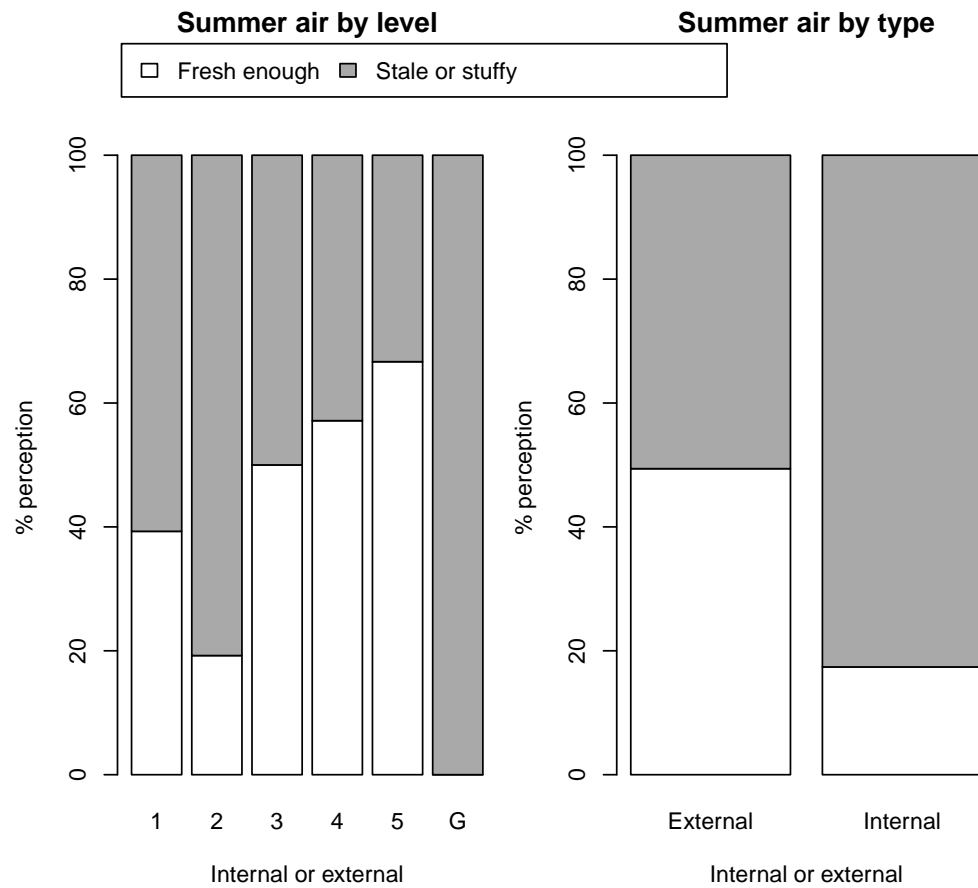
	level					
summer.temperature	1	2	3	4	5	G
Much too cold	0.0	0.0	0.0	0.0	0.0	0.0
Too cold	0.0	3.8	0.0	7.1	8.3	0.0
About right	60.7	42.3	46.2	42.9	33.3	0.0
Too hot	25.0	46.2	42.3	35.7	41.7	0.0
Much too hot	14.3	7.7	11.5	14.3	16.7	100.0



3.6 Where are the stale or stuffy offices?

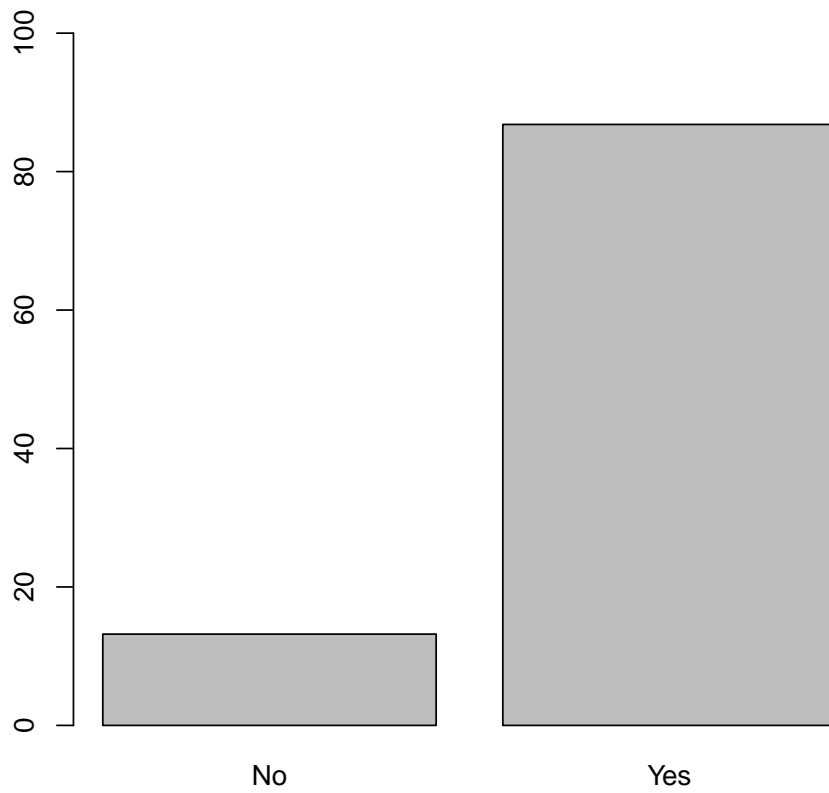
In order to find out where the stale and stuffy offices are, we looked at the summer data. The offices seem to be fairly evenly distributed between the levels, though possibly with Level 2 being more stuffy than the others. (Note that there was only one 1 respondent on the Ground level.) Internal offices seem much more likely to suffer from stuffiness than external ones.

	level					
summer.air	1	2	3	4	5	G
Fresh enough	39.3	19.2	50.0	57.1	66.7	0.0
Stale or stuffy	60.7	80.8	50.0	42.9	33.3	100.0

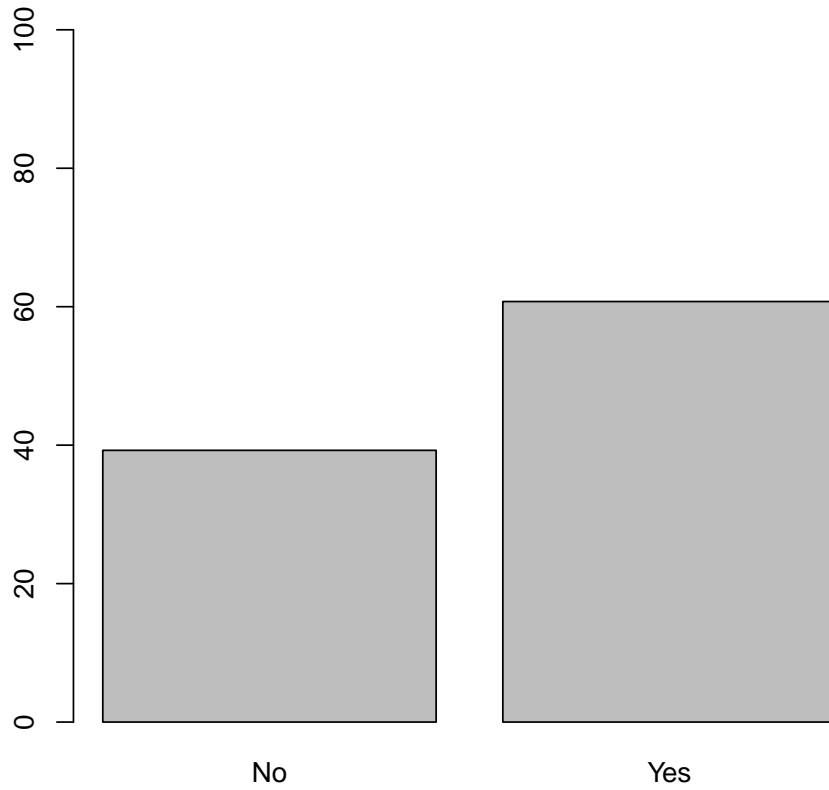


4 Control

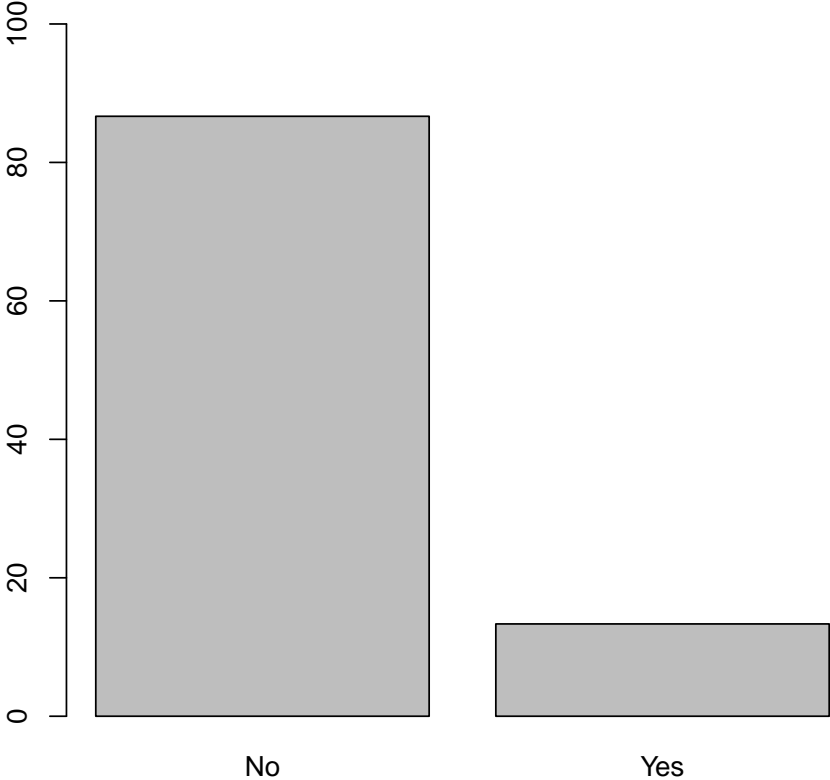
4.1 If you have a window do you open or close it to try to control the temperature?



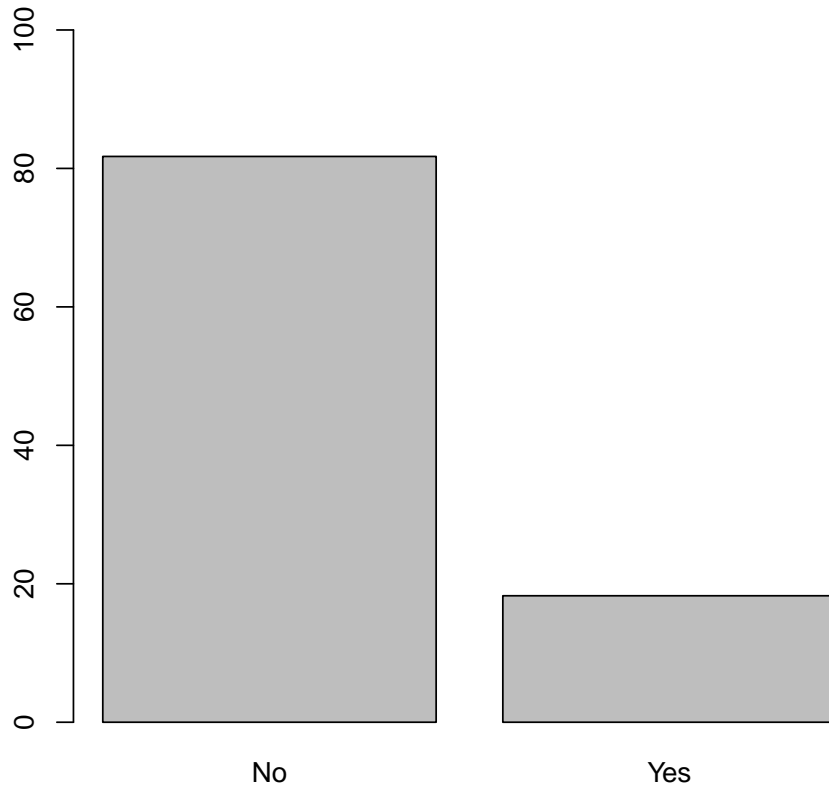
4.2 Do you leave your door open or closed to try to control the temperature?



4.3 Do you ever use an electric heater?

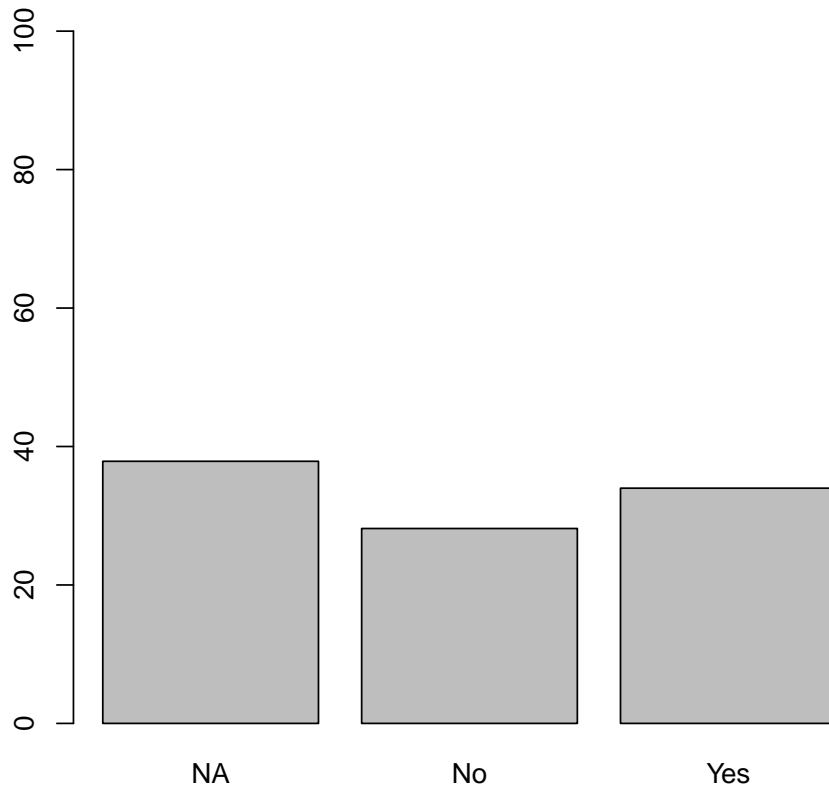


4.4 Do you ever use a fan?

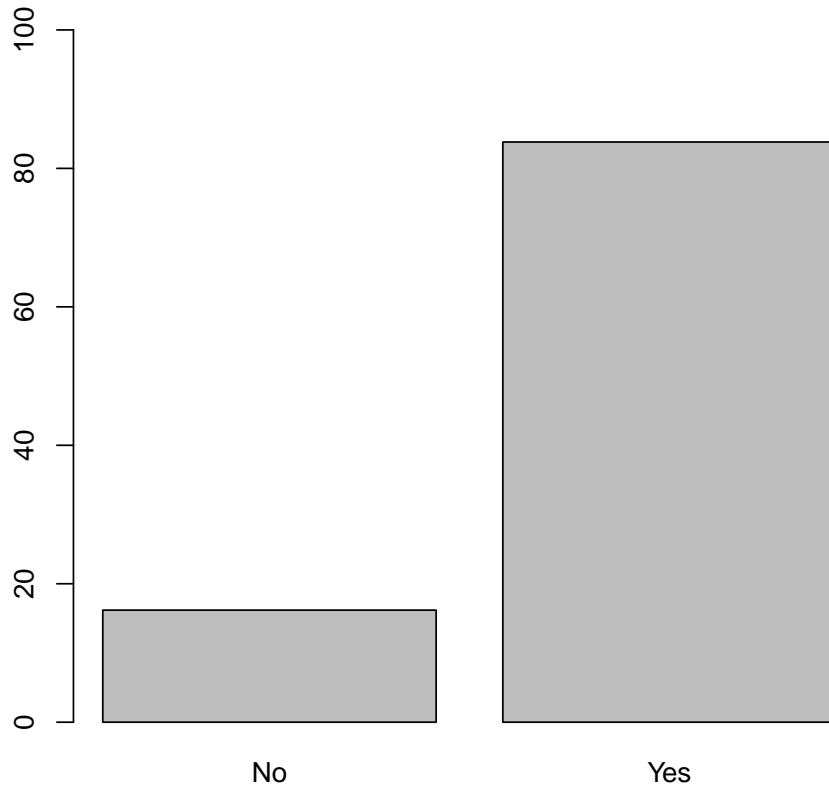


5 Computing

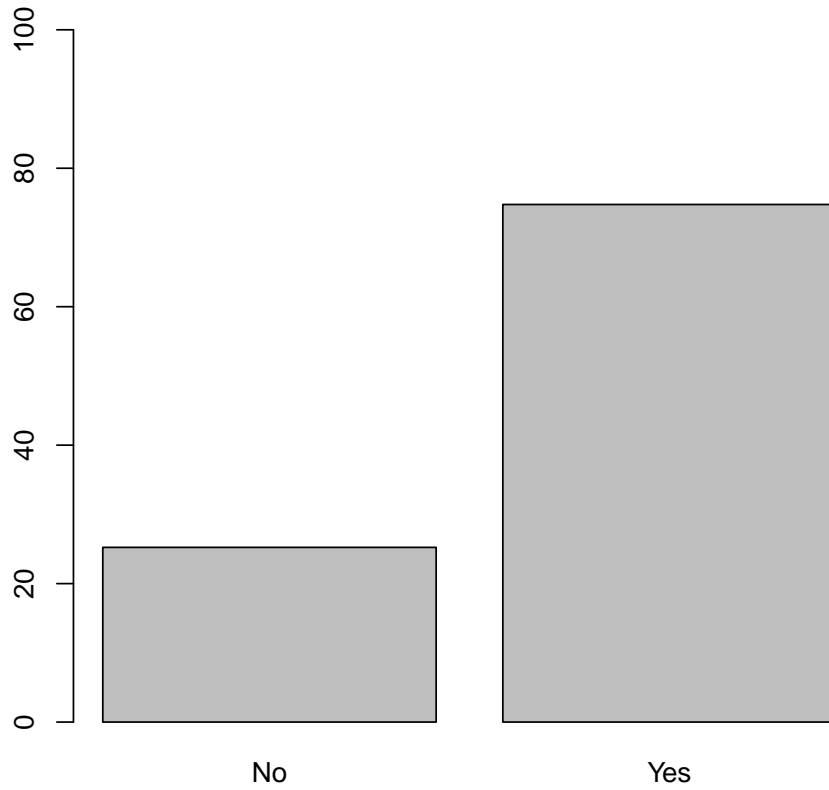
5.1 Are you aware that logging out of a DICE computer will allow it to sleep?



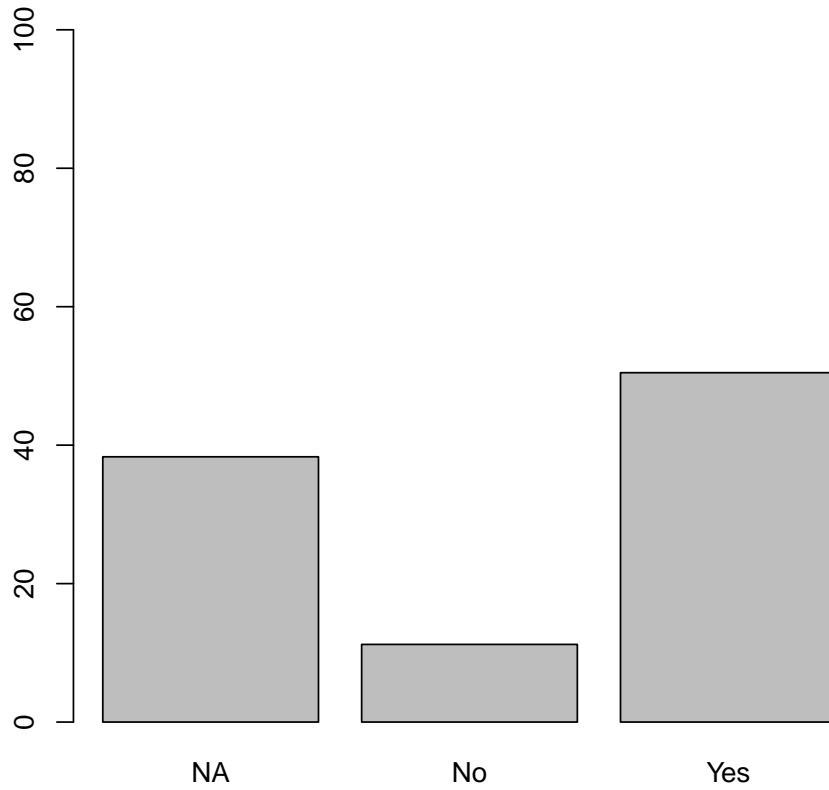
5.2 Do you know that you can wake a sleeping computer using the Wake-on-LAN service (<http://wake.inf.ed.ac.uk>)



5.3 If you use a DICE computer, do you log out at the end of the day or put it to sleep some other way?



5.4 If you use a non-DICE computer, do you turn it off or put it to sleep at the end of the day?



A Appendix

A.1 Survey

- Please give the number (e.g. 2.54) of your office in the Forum:
- In Winter (December-February)
 - Do you tend to feel Much too cold, Too cold, About right, Too hot, Much too hot
 - Does the air tend to feel Fresh enough Stale or stuffy
 - What is the thermostatic radiator valve usually set to? * 1 2 3 4 Not known
- In Spring (March-May)
 - Do you tend to feel Much too cold, Too cold, About right, Too hot, Much too hot
 - Does the air tend to feel Fresh enough Stale or stuffy
 - What is the thermostatic radiator valve usually set to? * 1 2 3 4 Not known
- In Summer (June-August)
 - Do you tend to feel Much too cold, Too cold, About right, Too hot, Much too hot
 - Does the air tend to feel Fresh enough Stale or stuffy
 - What is the thermostatic radiator valve usually set to? * 1 2 3 4 Not known
- In Autumn (September-November)
 - Do you tend to feel Much too cold, Too cold, About right, Too hot, Much too hot
 - Does the air tend to feel Fresh enough Stale or stuffy
 - What is the thermostatic radiator valve usually set to? * 1 2 3 4 Not known
- General questions
 - If you have a window do you open or close it to try to control the temperature? Yes No
 - If you have a window and don't open it, why not?
 - Do you leave your door open or closed to try to control the temperature? Yes No

- Do you ever use an electric heater? Yes No
- Do you ever use a fan? Yes No
- Are you aware that logging out of a DICE computer will allow it to sleep? Yes No
- Do you know that you can wake a sleeping computer using the Wake-on-LAN service (<http://wake.inf.ed.ac.uk>) Yes No
- If you use a DICE computer, do you log out at the end of the day or put it to sleep some other way? Yes No N/A
- If you use a non-DICE computer, do you turn it off or put it to sleep at the end of the day? Yes No N/A