

INTRODUCTION

Engineers are vital to society as they provide and maintain the infrastructure required to sustain a reasonable standard of living for all: for example, pure water to drink, fuel for heat and energy for living.

Engineers work at many skill levels. Professional engineers and engineering technicians are registered with the Engineering Council UK (ECUK) either as a Chartered Engineer (CEng), Incorporated Engineer (IEng) or Engineering Technician (EngTech).

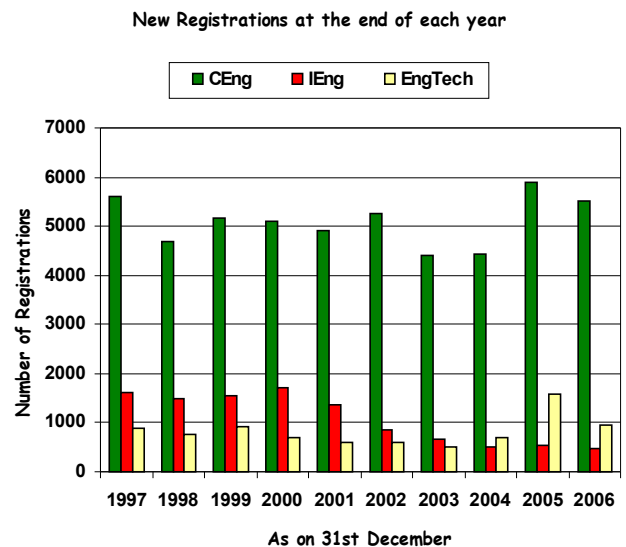
Registration provides engineers with professional status and is a mark of distinction for employers wishing to recruit the best engineering talent.

REGISTRATION PROFILE

The volume of *new* registrations by category at the end of each of the last ten years is given in the following table:

Year	Number of New Registrations			
	CEng	IEng	EngTech	Total
1997	5600	1600	900	8100
1998	4700	1500	750	6950
1999	5150	1550	910	7610
2000	5100	1700	700	7500
2001	4900	1350	600	6850
2002	5250	850	590	6690
2003	4400	650	500	5550
2004	4450	500	700	5650
2005	5900	550	1580	8030
2006	5500	490	950	6940
Total	50950	10740	8180	

We can represent this data in the form of bar charts and compare the volume of registrations as follows:



We can find the average (mean) number of new registrants by year or by category. For example, there were 8030 new registrants registered in year 2005. To find the average number of registrants per category:

$$\begin{aligned} \text{Average registrants} &= \frac{\text{Total number of registrants}}{\text{Number of Categories}} \\ &= \frac{8030}{3} \approx 2676 \end{aligned}$$

Similarly, we can find the average number of new CEng registrants each year over the last decade:

$$\begin{aligned} \text{Average CEng} &= \frac{\text{Total number of CEng}}{\text{Number of Years}} \\ &= \frac{50950}{10} = 5095 \end{aligned}$$

EXTENSION ACTIVITY – 1:

Find other means from the data given. What else you can conclude from the table and bar chart given?

For the last 10 years, we can find the percentage of all registrants in the three categories as follows:

$$\% \text{CEng} = \frac{50950}{69870} \times 100 \approx 73\%$$

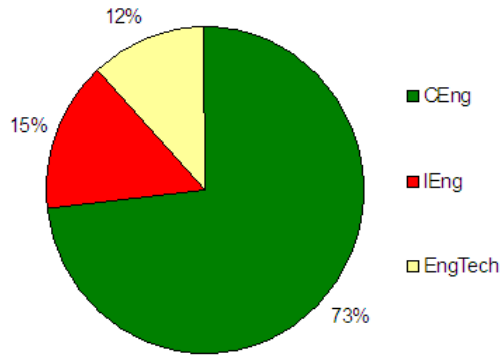
$$\% \text{IEng} = \frac{10740}{69870} \times 100 \approx 15\%$$

$$\% \text{EngTech} = \frac{8180}{69870} \times 100 \approx 12\%$$

$$\text{Or } \% \text{EngTech} = 100 - (73 + 15) \approx 12\%$$

Representing this information in the form of a pie chart, we get:

Total % of registrants in last 10 years by Category

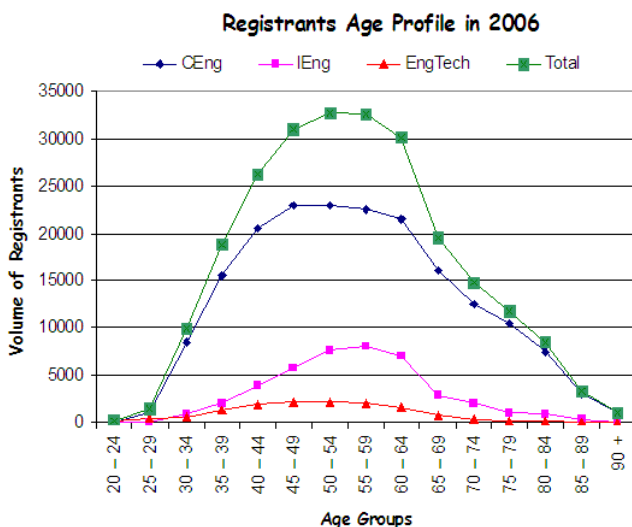


MEAN AGE PROFILE OF THE REGISTRANTS

Let us consider the age profile of those registered as engineers and technicians in 2006. The data that has been collected is shown in the following table:

Age	Volume of Registrants in 2006			
	CEng	IEng	EngTech	Total
20 – 24	0	0	100	100
25 – 29	1000	0	400	1400
30 – 34	8500	800	600	9900
35 – 39	15500	2000	1350	18850
40 – 44	20500	3900	1800	26200
45 – 49	23000	5800	2200	31000
50 – 54	23000	7600	2100	32700
55 – 59	22500	7990	2000	32490
60 – 64	21500	7000	1600	30100
65 – 69	16000	2900	650	19550
70 – 74	12500	1990	250	14740
75 – 79	10500	1000	200	11700
80 – 84	7500	800	100	8400
85 – 89	3000	300	0	3300
90 +	1000	0	0	1000

We can plot a line graph to see the nature of this data which is shown in the following graph:



Let us calculate the mean age of all registrants under the category of CEng as follows:

Age Group	Mid-Value x	CEng f	$x \times f$
20 – 24	22	0	0
25 – 29	27	1000	27000
30 – 34	32	8500	272000
35 – 39	37	15500	573500
40 – 44	42	20500	861000
45 – 49	47	23000	1081000
50 – 54	52	23000	1196000
55 – 59	57	22500	1282500
60 – 64	62	21500	1333000
65 – 69	67	16000	1072000
70 – 74	72	12500	900000
75 – 79	77	10500	808500
80 – 84	82	7500	615000
85 – 89	87	3000	261000
90 +	95	1000	95000
Total		186000	10377500

$$\text{Mean CEng} = \frac{10377500}{186000} \approx 55.79 \approx 55 \text{ years}$$

EXTENSION ACTIVITY – 2:

Calculate mean age for the other two categories, i.e. for IEng and EngTech.

(Answers: 55 years and 50 years, respectively)

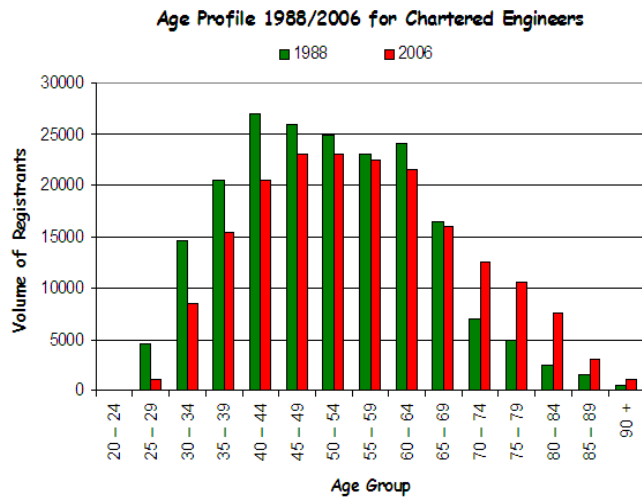
Similar data is available for the year 1988 and is shown in the following table:

Age	Volume of Registrants in 1988			
	CEng	IEng	EngTech	Total
20 – 24	0	100	90	190
25 – 29	4500	1900	1250	7650
30 – 34	14500	5990	2100	22590
35 – 39	20500	9100	2550	32150
40 – 44	27000	12600	3700	43300
45 – 49	26000	8900	2800	37700
50 – 54	24900	7400	1900	34200
55 – 59	23000	5400	1250	29650
60 – 64	24000	3900	650	28550
65 – 69	16500	1990	350	18840
70 – 74	7000	1000	90	8090
75 – 79	5000	500	50	5550
80 – 84	2500	50	0	2550
85 – 89	1500	0	0	1500
90 +	500	0	0	500

EXTENSION ACTIVITY – 3:

Obtain a line graph for this data from 1988 and comment on the mean age during that year for the three categories.

When we draw an age profile graph for CEng in the years 1988 and 2006, we get:



We can clearly see from this chart that there has been a significant decline in the volumes of registered Chartered Engineers in all age groups under 69 between 1988 and 2006, equivalent to a 22% fall.

EXTENSION ACTIVITY – 4:

Draw a similar bar chart for the IEng and EngTech data available for the two years. What can you deduce from those bar charts? Justify your findings.

MEDIAN AGE PROFILE OF THE REGISTRANTS

Rearranging the given data for the two years, we can calculate the median age by calculating the cumulative frequency as shown in the following table. For the year 1988, $\frac{271010}{2} = 135505$ lies in the 45 – 49 age group, whereas for the year 2006, $\frac{241430}{2} = 120715$ lies in the 55 – 59 age group. Hence, we can deduce that the median age of all registrants in the year 1988 is about 45 years, whereas in 2006 it increased to about 55 years. So, in 18 years the median age has risen by 10 years.

Age	Registrants: 1988		Registrants: 2006	
	Total	Cumulative Frequency	Total	Cumulative Frequency
20 – 24	190	190	100	100
25 – 29	7650	7840	1400	1500
30 – 34	22590	30430	9900	11400
35 – 39	32150	62580	18850	30250
40 – 44	43300	105880	26200	56450
45 – 49	37700	143580	31000	87450
50 – 54	34200	177780	32700	120150
55 – 59	29650	207430	32490	152640
60 – 64	28550	235980	30100	182740
65 – 69	18840	254820	19550	202290
70 – 74	8090	262910	14740	217030
75 – 79	5550	268460	11700	228730
80 – 84	2550	271010	8400	237130
85 – 89	1500	272510	3300	240430
90 +	500	273010	1000	241430

What does this increase in median age of all registrants tell us about the dataset?

It is a clear indication that the numbers of young people entering the profession are too small to hold the median constant. But it also shows a positive point that there are some young people entering into the profession, otherwise the median age would have risen by 18 years in 18 years.

EXTENSION ACTIVITY – 5:

Obtain a similar result for the median age profile of registrants according to the three categories given. Comment on your findings.

WHERE TO FIND MORE

1. *Basic Engineering Mathematics*, John Bird, 2007, published by Elsevier Ltd.
2. *Engineering Mathematics*, Fifth Edition, John Bird, 2007, published by Elsevier Ltd.
3. *Engineering UK 2007*, Research Report December 2007, published by The Engineering and Technology Board (ETB) in association with ECuk.



Andrew Vernon Ramsay MA CEng FIET FCIS – Chief Executive, Engineering Council UK

Andrew Ramsay has been Chief Executive Officer of the Engineering Council UK, the national regulation authority for the UK engineering profession, since 2002. Previously he held posts in its predecessor Engineering Council, including as Director for Engineers' Regulation and as Acting Director-General. Educated at Cambridge and as an AEI Rugby indentured apprentice, Andrew spent 13 years in industry working for GEC and the CEBG before joining CIBSE. He is a Chartered Engineer and a Chartered Secretary.

He says: *I trained as an electrical engineer working on large electrical power plant and machines, though my work now involves me in ensuring the quality of professional engineers and technicians in the UK. Much of the current power system is reaching the end of its life and there is a strong demand for electrical engineers to design and build replacement power generators, this time with a view to reducing CO₂ output. Mathematical skills are essential to practise as a professional engineer.*

INFORMATION FOR TEACHERS

The teachers should have some knowledge of

- How to find Mean and Median of a given data set (grouped or ungrouped)
- How to plot a graph using software like Excel or Autograph
- How to interpret the data in real world language

TOPICS COVERED FROM “MATHEMATICS FOR ENGINEERING”

- Topic 8: Statistics and Probability

LEARNING OUTCOMES

- LO 08: Understand how to describe situations using statistics and use probability as a measure of likelihood
- LO 10: Comprehend translations of common realistic engineering contexts into mathematics

ASSESSMENT CRITERIA

- AC 8.1: Summarise a set of data
- AC 10.1: Read critically and comprehend longer mathematical arguments or examples of applications.

LINKS TO OTHER UNITS OF THE ADVANCED DIPLOMA IN ENGINEERING

- Unit-1: Investigating Engineering Business and the Environment
- Unit-8: Mathematical Techniques and Applications for Engineers