

## L2 Probability Revision #1

1. The properties in a town are surveyed and found to be, according to the type of ownership:

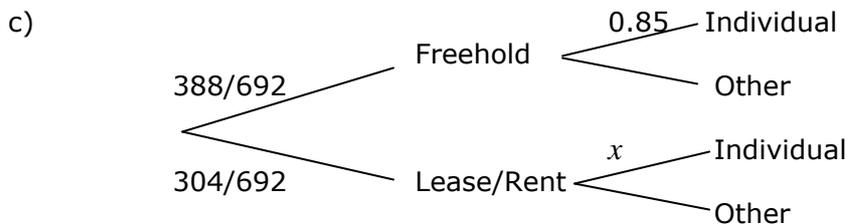
	Freehold	Leasehold	Rental
Residential	372	6	241
Commercial	16	42	15

- a) What proportion of properties are rental?
- b) What is the probability a leasehold property is residential?
- c) If 65% of the total properties in the town are owned by individuals (the rest by companies etc), but 85% of the freehold properties are, what proportion of the (combined) leasehold and rental properties are owned by individuals?
2. The mean length for a house to be rented is 3.2 years, with a standard deviation of 1.4 years.
- a) What is the probability new tenant will rent a house for over 2 years?
- b) How many months do the shortest 5% of tenants stay?
- c) Why is the distribution of rental length unlikely to be truly normal?
3. A real estate agency had 80 properties come onto its books during a year. It went on to sell 68 of them.
- a) If the total number of properties that went onto the market during that year was 165, predict how many of them sold.
- b) What assumption did you have you make in a) and how likely do you think that assumption is to be true?
- c) Of the 80 properties for sale at the agency, 16 were commercial. Of the commercial properties only 7 sold.
- An agent says that that the relative risk that commercial properties fail to sell is ten times as high as that for residential properties. Do the figures above bear that out?

## Answers: L2 Probability Revision #1

1.

- a) 692 properties of which 256 are rental.  $P(\text{rental}) = 256/692 = \mathbf{0.3699}$
- b) 48 leaseholds of which 6 are residential.  $P(\text{leasehold is residential}) = 6/48 = \mathbf{1/8 = 0.125}$



Given that  $\frac{388}{692} \times 0.85 + \frac{304}{692} \times x = 0.65$  Solving gives  $x = \mathbf{0.395}$

2.

- a) Graphics normal distribution: Ncd: lower = 2, upper = 9999,  $\sigma = 1.4$ ,  $\mu = 3.2$   
 $P(x > 2) = \mathbf{0.804}$
- b) Graphics normal distribution: InvN: tail = left, area = 0.05,  $\sigma = 1.4$ ,  $\mu = 3.2$   
 limit = 0.8972 years, which  $\times 12 = 10.76$  months. Generally rent is in fortnights or weeks, so answer = **under 11 months** (or 10 months 3 weeks)  
 (Alternatively, as above, but use  $\sigma = 50.4$  months,  $\mu = 38.4$  months)
- c) The main reason why it is unlikely to be normal is that **the distribution is likely to be quite asymmetric**. The tenants cannot stay less than 0 months, and obviously very few are going to stay only one or two. So that side of the distribution must be quite compressed. On the other side of the distribution, however, there will likely be quite a long "tail".  
 In our example, about 10% of tenants stay 5 years, but effectively no-one stays more than 8 years. This is unlikely to be true in reality.

3.

- a) For the agency sales rate was  $\frac{68}{80}$ . So predict  $\frac{68}{80} \times 165 = 140.25$ .  
 Prediction is **140 properties sold**. (Must round to whole number in this context.)
- b) Need to assume that the agency gets a **representative** spread of the whole town's properties. That is, it gets a typical selection of the properties, not just all the easy to sell or all the hard to sell. Given it has half the market, it seems reasonable.
- c) Risk commercial is unsold is  $9/16 = 0.5625$ . Risk residential unsold =  $3/52 = 0.0577$ .  
 Relative risk =  $0.5625 \div 0.0577 = \mathbf{9.75}$ . Almost 10 times, but not quite.  
 Close enough considering the variation implicit in using such small quantities.