

Astronomy A3/A4H
Statistical Astronomy I: Example Sheet 1

1. A bowl contains 8 coloured chips: 5 red and 3 green. A chip is drawn at random from the bowl, its colour noted, and then replaced in the bowl. This procedure is repeated a second time.

- What is the probability that both chips are the same colour
- What is the probability that the two chips are different colours

A single blue chip is then added to the bowl. Three chips are drawn in turn at random from bowl, but are NOT replaced before the next chip is drawn.

- What is the probability that the first chip is red and the second chip is green?
- What is the probability that the first chip is blue, the second chip red and the third chip green?
- What is the probability that at least one of the three chips is green?

2. The distribution of the luminosity of brightest cluster galaxies can be modelled to be of exponential form, viz:-

$$p(L) = A \exp\left[-\frac{L - L_*}{\Delta}\right], L > L_*, \Delta > 0$$

where A , L_* and Δ are constant parameters.

- Determine the value of A which makes $p(L)$ a properly normalised pdf, i.e. one which integrates to unity
- Using this pdf, determine the mean and variance of L
Hint: use integration by parts, or use the definition of the gamma function:-

$$\int_0^\infty x^{n-1} e^{-x} dx = (n-1)!$$

- Derive an expression for the cdf of L , $P(L)$
- Using the cdf, calculate the median value of L . Is the median greater than, equal to or less than the mean?

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