Durham University
MATH1541 Statistics
Exercise Sheet 13

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0.1 Q1

0.1.1 a)

The probability of a student passing the exam is not constant, as a student's understanding is dependent on many other factors, thus a binomial distribution is not appropriate in this case.

0.1.2 b)

Again the probability of getting a correct answer is not constant or independent (later questions are dependent on good understanding of earlier material), thus a binomial distribution will not give a good answer.

0.2 c)

The differing temperatures likely affect the probability of material failure, and the fact the same material is being used for this test means the experiment is independent - once again, a binomial distribution will not be conducive to correct calculations.

0.3 Q4

0.3.1 a)

0.3.2 b)

0.3.3 c)

0.4 Q5

0.4.1 a)

If we assume the probability, 0.4, of a person being a Conservative voter, and that each person's probability of voting that way is independent, then we also have a binary choice (Tory voter, or not), thus allowing us to model Y as binomial.

0.4.2 b)

y	0	1	2	3	4	5	6
P$(Y = y)$	0.04666	0.1866	0.3110	0.2765	0.1382	0.03686	4.096×10^{-3}

0.4.3 c)

$\text{E}(Y) = \sum_{i=0}^{6} y \cdot \text{P}(Y = y)$
$\text{E}(Y) = 2.3998$
$\text{Var}(Y) = \left(\sum_{i=0}^{6} y^2 \cdot \text{P}(Y = y) \right) - \text{E}(Y)^2$
$\text{Var}(Y) = 7.1993 - 2.3998^2 = 1.4402$

0.4.4 d)

$np = 2.4$
$np(1 - p) = 1.44$

0.4.5 e)

$Y \sim \text{B}(900, 0.4)$
$Z \sim \text{N}(360, (6\sqrt{6}^2))$
$\text{P}(333 \leq Y \leq 378) \approx \text{P}(332.5 \leq Z \leq 378.5)$
$\text{P} = 0.8653$

0.4.6 f)

$P = \frac{Y}{900}$
Assume $P \sim \text{N}(0.4, 2.67 \times 10^{-4})$

0.4.7 g)

0.4.8 h)