| **Question** | **Scheme** | **Marks** |
| --- | --- | --- |
| **1(a)** |  | B1 B1 |
| *X* ~ B(30, 0.15) | M1 |
| P(*X* < 1) = 0.0480 or CR: *X* = 0 | A1 |
| (0.0480 > 0.025)  |  |
| not a significant result or do not reject or not in CR | M1 |
| there is no evidence of a change in the proportion of customers buying an item from the display. | A1ft |
|  |  | **(6)** |
| **1(b)** |  | B1 |
| Let *S* = the number who buy sandwiches, *S* ~B(120, 0.2), |  |
|  | M1 A1 |
| P(*S* > 31) = P(*W* > 30.5) | M1 |
|  =  or =1.2816  | M1 |
|  [= P(*Z* >1.48..) ]  |  |
|  = 1 - 0.9306  | M1 |
|  = 0.0694 *x* = 30.1 | A1 |
|  < 0.10 so a significant result, there is evidence that more customers are purchasing sandwiches or the shopkeepers claim is correct. | B1ft |
|  |  | **(8)** |
|  |  | **(14 marks)** |
| **2(a)** | A statement concerning a **population parameter**  | B1 |
| A critical region is the range / set of values / answers **or** a test statistic **or** region/area **or** values (where the test is significant)that would lead to the rejection of H0 / acceptance of H1 | B1B1 |
|  |  | **(3)** |
| **2(b)** | H0 : *p* = 0.45 H1 : *p <* 0.45 (or p0.45) |  |
| *X* ~ B(20, 0.45) | M1 |
| P(*X*  5) = 0.0553 CR *X*  4  | A1 |
| Accept H0. Not significant. 5 does not lie in the Critical region. | M1d |
| There is no evidence that the proportion who voted for Mrs George is not 45% or there is evidence to support Mrs George’s claim  | A1cso |
|  |  | **(4)** |
| **2(c)** | B(8, 0.45): P(0) = 0.0084  | M1 |
| B(7, 0.45): P(0) = 0.0152  | A1 |
| Hence smallest value of *n* is **8** | B1 |
|  |  | **(3)** |
|  | Alternative |  |
| (0.55)*n* < 0.01 | M1 |
| *n*log0.55 < log 0.01 |  |
| *n* > 7.7… | A1 |
| Hence smallest value of *n* is **8** | B1cso |
|  |  | **(10 marks)** |
| **3(a)** | *n* is large and *p* close to 0.5 | B1B1 |
|  |  | **(2)** |
| **3(b)** | There would be no pea seeds left  | B1 |
|  |  | **(1)** |
| **3(c)** | H0: *p* = 0.55 H1 : *p* ≠ 0.55  | B1 |
|  | **(1)** |
| *X*~N(121, 54.45)  | B1 |
| P(*X* ≥ 134.5) =  or 1.96 | M1M1A1 |
|  = P( Z ≥ 1.8295..)  |  |
|  = 1 – 0.9664 |  |
|  = 0.0336/0.0337 *x* = 135.96 | A1 |
| Accept H0 not in CR, not significant  | M1 |
| The **company’s claim** is justified **or** **55**% of its pea **seeds germinate** | A1cso |
|  |  | **(7)** |
|  | **Alternative** |  |
| *X*~N(99, 54.45)  | B1 |
| P(*X* ≤ 85) = $P\left(Z\leq \frac{85.5-99}{\sqrt{54.45}}\right)$ or 1.96 | M1 M1 A1 |
|  = P( Z ≥ 1.8295..)  |  |
|  = 1 – 0.9664 |  |
|  = 0.0336/0.0337 *x* = 107.5 |  |
|  |  |
| Accept H0 not in CR, not significant  | M1 |
| The **company’s claim** is justified **or** **55**% of its pea **seeds germinate** | A1cso  |
|  |  | **(11 marks)** |
| **4** | *X* ~ N(40, 32) ~ N (40,) (Condone *Y* ~ N(40, )  | B1 |
| P( > 42) =P( *Z* > )  | M1 |
|  | B1dM1 |
| *n* > 6.087 |  |
| *n* = 7 | A1 |
|  |  | **(5 marks)** |
| **5(a)** | *z* =  3.2905 | B1 |
| $σ$ = $\frac{30}{3.2905}$  | M1 |
| $σ$ = 9.117 \*\* | A1cso |
|  |  | **(3)** |
| **5(b)** | H0 :  H1 :  | B1 |
| mean weight = 999.54 | B1 |
|  *z* = $\frac{\overbar{x}-μ}{\frac{σ}{\sqrt{n}}}$ = $\frac{(999.54-1000)}{\frac{9.117}{\sqrt{10}}} =-0.160$ or  | M1A1 |
| 1% critical value = $-$ 2.3263 | B1 |
| $-$ 2.3263 < $-0.160$ |  |
| Accept H0 / not in critical region | dM1 |
|  There is no evidence that that the machine is delivering packets of mean weight less than 1 kg | A1ft |
|  |  | **(7)** |
|  |  | **(10 marks)** |

|  |  |  |  |  |  |
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|  | **Source paper** | **Question number** | **New spec references** | **Question description** | **New AOs** |
| 1 | S2 2011 | 6 | A 4.1, 4.2, 5.1, 5.2, 5.3 | Binomial distribution, Normal distribution | 1.1b, 2.2b, 2.5, 3.3, 3.5a |
| 2 | S2 Jan 2013 | 6 | A 5.1, 5.2 | Hypothesis testing, Tests on binomial | 1.1b, 1.2, 2.5, 3.3, 3.5a |
| 3 | S2 2014 | 5 | A 4.1, 4.2, 5.1, 5.3 | Continuous distributions, Hypothesis tests | 1.1b, 1.2, 2.2b, 2.4, 2.5, 3.3, 3.4 |
| 4 | S3 2013R | 2 | A 5.3 | Tests on normal mean | 1.1b, 2.1, 3.1b, 3.4 |
| 5 | S3 2014 | 7 | A 5.3 | Tests on normal mean | 1.1b, 2.1, 2.2b, 2.5, 3.1b, 3.4 |