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| 2    | est ( $\mu$ ) = 499.5 or 29970/60                                                                                                         |
|      | est ( $\sigma^2$ ) = $\frac{60}{59} \left( \frac{14970300}{60} - '499.5'^2 \right)$ or $1/59(14970300 - (29970)^2/60)$                    |
|      | = 4.83 or 285/59                                                                                                                          |
|      | H <sub>0</sub> : Pop mean (or $\mu$ ) = 500<br>H <sub>1</sub> : Pop mean (or $\mu$ ) $\neq$ 500                                           |
|      | $\frac{'499.5'-500}{\frac{\sqrt{'4.83'}}{\sqrt{60}}}$                                                                                     |
|      | = -1.762                                                                                                                                  |
|      | '1.762' < 1.96 or -'1.762' > -1.96<br>0.0390 > 0.025                                                                                      |
|      | There is insufficient evidence that [mean ] mass is not 500g                                                                              |
| 5(a) | $P(X \leq 2) = 0.8^{40} + 40 \times 0.8^{39} \times 0.2 + {}^{40}C_2 \times 0.8^{38} \times 0.2^2$<br>= 0.0001329 + 0.0013292 + 0.0064799 |
|      | = 0.00794 ( < 0.025 )                                                                                                                     |
|      | $P(X \leq 3) = [0.00794 + {}^{40}C_3 \times 0.8^{37} \times 0.2^3]$<br>= 0.0079421 + 0.0205199 = 0.0285 > 0.025                           |
|      | P(Type I) = 0.00794 (3 sf) with both relevant comparisons seen                                                                            |
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| 5(b) | Rejection region is $X \leq 2$                                            |
|      |                                                                           |
| 5(c) | H <sub>0</sub> will be rejected<br>Or result lies in the rejection region |
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| 4(a) | Assume flaws in cups are independent OR prob of containing a flaw is the same for all cups                                                                                                             |
|      | H <sub>0</sub> : P(contains flaw) = 0.18<br>H <sub>1</sub> : P(contains flaw) < 0.18                                                                                                                   |
|      | $[P(X \leq 3) =] 0.82^{40} + 40 \times 0.82^{39} \times 0.18 + {}^{40}C_2 \times 0.82^{38} \times 0.18^2 + {}^{40}C_3 \times 0.82^{37} \times 0.18^3$<br>= 0.0003569 + 0.0031338 + 0.013414 + 0.037298 |
|      | 0.0542 (3 sf)                                                                                                                                                                                          |
|      | 0.0542 > 0.05                                                                                                                                                                                          |
|      | [Accept H <sub>0</sub> ] Insufficient evidence to accept factory owners claim.<br>[Insufficient evidence that percentage less than 18%]                                                                |
|      |                                                                                                                                                                                                        |
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| 4(b) | $np = 7.2$ which is too large, or $> 5$ .<br>Or $n = 40$ which is not greater than 50.<br>Or $p = 0.18$ which is not small or $> 0.1$ .                                                                                                                                                                                             |
| 6(a) | Assume sd is still 26 or is unchanged<br><br>$H_0$ : Population mean = 736<br>$H_1$ : Population mean < 736<br><br>$\pm \frac{725-736}{\frac{26}{\sqrt{35}}}$<br><br>$= -2.503$<br><br>$-2.503 < -2.054$ (or 5 or 6) or $0.0062 < 0.02$<br><br>[Reject $H_0$ ] There is sufficient evidence that (mean) weekly profit has decreased |
| 6(b) | 0.02                                                                                                                                                                                                                                                                                                                                |

|      |                                                         |
|------|---------------------------------------------------------|
| 6(c) | $\frac{a-736}{\frac{26}{\sqrt{35}}} = -2.054$ or -2.055 |
|      | $a = 726.973$                                           |
|      | $\frac{'726.973'-718}{\frac{26}{\sqrt{35}}} (= 2.042)$  |
|      | $= 1 - \Phi('2.042')$                                   |
|      | $= 0.0203$ to $0.0207$                                  |

|      |                                                                                                          |
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| 3(a) | $\text{Est}(\mu) = \frac{2750}{60}$ or $\frac{275}{6}$ or 45.8 (3 sf)                                    |
|      | $\text{Est}(\sigma^2) = \frac{60}{59} \left( \frac{127000}{60} - \left( \frac{275}{6} \right)^2 \right)$ |
|      | $= 16.2$ (3 sf) or $\frac{2875}{177}$                                                                    |

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| 3(b) | $H_0$ : Population mean time = 45 $H_1$ : Population mean time > 45                                                                                                                                                                                 |
|      | $\frac{\frac{275}{6} - 45}{\sqrt{\frac{16.24294}{60}}}$                                                                                                                                                                                             |
|      | = 1.602 to 1.595                                                                                                                                                                                                                                    |
|      | '1.602' < 1.645                                                                                                                                                                                                                                     |
|      | [Accept $H_0$ ]<br>There is insufficient evidence [at 5% level] to reject the company's claim<br>OR There is insufficient evidence to accept the passenger's belief<br>OR There is insufficient evidence that the mean time is more than 45 minutes |
| 6(a) | $H_0$ : Proportion (at college) owning Pumpkin phone = 0.25<br>$H_1$ : Proportion (at college) owning Pumpkin phone < 0.25                                                                                                                          |
|      |                                                                                                                                                                                                                                                     |
| 6(b) | B(30, 0.1) and $P(X \geq 5)$ attempted                                                                                                                                                                                                              |
|      | $1 - (0.9^{30} + 30 \times 0.9^{29} \times 0.1 + {}^{30}C_2 \times 0.9^{28} \times 0.1^2 + {}^{30}C_3 \times 0.9^{27} \times 0.1^3 + {}^{30}C_4 \times 0.9^{26} \times 0.1^4)$<br>= 1 – (0.042391 + 0.141304 + 0.22766 + 0.236088 + 0.177066)       |
|      | = 0.175 (3 sf) accept 0.176                                                                                                                                                                                                                         |
|      |                                                                                                                                                                                                                                                     |
| 6(c) | $\frac{1}{8} \pm z \sqrt{\frac{\frac{1}{8} \times \frac{7}{8}}{40}}$                                                                                                                                                                                |