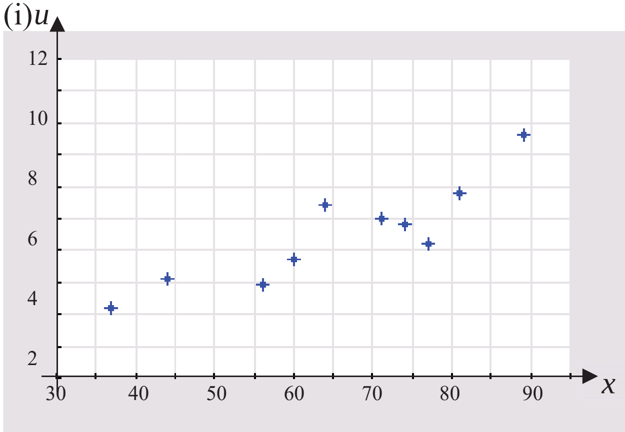
Qn	
5(i)	Number of ways $= \dfrac{9!}{2!2!3!} = 15120$
5(ii)	Number of ways $= \dfrac{7!}{3!} = 840$
5(iii)	Number of ways $= \dfrac{5!}{2!} \cdot {}^{6}C_{3}$ $= 1200$
5(iv)	Let the event D be such that the D's are together, the event E be such that the E's are together and S be such that the S's are together. $n(D \cup E \cup S) = n(D) + n(E) + n(S) - n(D \cap E)$ $- n(E \cap S) - n(D \cap S) + n(D \cap E \cap S)$ $= \dfrac{8!}{2!3!} + \dfrac{7!}{2!2!} + \dfrac{8!}{2!3!} - \dfrac{6!}{2!} - \dfrac{6!}{2!} - \dfrac{7!}{3!} + 5!$ $= 6540$ Number of ways $= n(D' \cap E' \cap S')$ $= n(S) - n(D \cup E \cup S)$ $= 15120 - 6540$ $= 8580$

Qn	
6(i)	Let X denotes the number of 1-year old flares that fail to fire successfully, out of the 100, $X \sim \mathrm{B}(100,\ 0.005)$ $\mathrm{P}(X \le 2) = 0.985897 \approx 0.986$
6(ii)	Let Y denotes the number of boxes with a hundred 1-year old flares with at most 2 that fail to fire, out of 50 boxes, ie $Y \sim \mathrm{B}(50,\ 0.985897)$ $\mathrm{P}(Y \le 48) = 0.156856 \approx 0.157$
6(iii)	Let T denotes the number of 10-year old flares that fire successfully, out of the 6, $T \sim \mathrm{B}(6,\ 0.75)$ (a) Required prob = $(1-0.970)\times \mathrm{P}(T \ge 4)$ $= 0.03\times\left(1-P(T \le 3)\right)$ $= 0.0249$ (b) P(at least 4 of the 7 flares fire successfully) $= 0.024917 + 0.970 \times \mathrm{P}(T \ge 3)$ $= 0.024917 + 0.970 \times \left(1-\mathrm{P}(T \le 2)\right)$ $= 0.958$

Qn	
7(i)	Let X be the rv denoting the amount of time taken by a cashier to deal with a randomly chosen customer, ie $X \sim \mathrm{N}(150,\ 45^2)$. $\mathrm{P}(X > 180) = 0.25249 \approx 0.252$
7(ii)	Assume that the time taken to deal with each customer is independent of the other, ie $X_1 + X_2 \sim \mathrm{N}(2\times 150, 2\times 45^2)$ $\mathrm{P}(X_1 + X_2 < 200) = 0.058051 \approx 0.0581$
7(iii)	Let Y be the rv denoting the amount of time taken by a the second cashier to deal with a randomly chosen customer, ie $Y \sim \mathrm{N}(150,\ 45^2)$. $X_1 + X_2 + X_3 + X_4 \sim \mathrm{N}(4\times 150, 4\times 45^2)$ and $Y_1 + Y_2 + Y_3 \sim \mathrm{N}(3\times 150, 3\times 45^2)$ $\mathrm{P}(X_1 + X_2 + X_3 + X_4 < Y_1 + Y_2 + Y_3) = \mathrm{P}(X_1 + X_2 + X_3 + X_4 - (Y_1 + Y_2 + Y_3) < 0)$ Using $X_1 + X_2 + X_3 + X_4 - (Y_1 + Y_2 + Y_3) \sim N(150, 7\times 45^2)$ $\mathrm{P}(X_1 + X_2 + X_3 + X_4 - (Y_1 + Y_2 + Y_3) < 0) = 0.10386 \approx 0.104$

Qn	
8(i)	(i)
8(ii)	Using GC, $r = 0.884$ for the model $u = ax + b$ $u = ae^{bx} \Rightarrow \ln u = bx + \ln a$ Using GC, $r =$ 0.906 for the model $u = ae^{bx}$ Since the value of r is closer to 1 for the 2nd model, $u = ae^{bx}$ is a better model. $\ln u = 0.013633x + 0.94964$ $u = e^{0.013633x+0.94964}$ $u = 2.58e^{0.0136x} = 2.6e^{0.014x}$
8(iii)	$7 = 2.58e^{0.0136x} \Rightarrow x = \dfrac{\ln\left(\dfrac{7}{2.58}\right)}{0.0136} = 73.391 \approx 73$ A patient with urea serum is 7 mmol per litre is approximately 73 years old. Since $r = 0.906$ is close to 1 and 7 is within the data range of urea serum, estimate is reliable.
8(iv) (a)	The product moment correlation coefficient in part **(ii)** will not be changed if the units for the urea serum is given in mmol per decilitre.
8(iv) (b)	$u = 0.258e^{0.0136x}$

Qn	
9(i)	$\mathrm{P}(X=2)=\frac{18}{18}\frac{2}{17}\frac{15}{16}\frac{3!}{2!}$ $=\frac{45}{136}$ $\mathrm{P}(X=0)=\frac{18}{18}\frac{15}{17}\frac{12}{16}$ $=\frac{45}{68}$ $\mathrm{P}(X=3)=\frac{18}{18}\frac{2}{17}\frac{1}{16}$ $=\frac{1}{136}$
9(ii)	$\mathrm{E}(X)=\frac{93}{136}$ $\mathrm{E}(X^2)=0\times\frac{45}{68}+2^2\times\frac{45}{136}+3^2\times\frac{1}{136}=\frac{189}{136}$ $\mathrm{Var}(X)=\frac{189}{136}-\left(\frac{93}{136}\right)^2$ ≈ 0.922
9(iii)	Since $n=40$ is large, by Central Limit Theorem, $\bar{X}\sim N\left(\frac{93}{136},\frac{0.922}{40}\right)$ approximately $P(\bar{X}>1)=0.0186$

Qn	
9(iv)	Expected winnings = $-\frac{45}{68}a+\frac{45}{136}\left(a+10\right)+\frac{1}{136}(a+10)$ $-\frac{11}{34}a+\frac{115}{34}>0$ $a<\frac{115}{11}$ $a<10.\dot{4}\dot{5}$ The possible amounts will be $1\le a\le 10$ and $a\in\mathbb{Z}$.

Qn	
10(i)	Let X be the thickness of the coating on a randomly chosen computer device. Let μ be the mean thickness of the coating of a computer device. Assume that the standard deviation of the coating of a computer device remains unchanged. To test : $\begin{array}{l} H_0 : \mu = 100 \\ H_1 : \mu \neq 100 \end{array}$ Level of Significance: 5% Under H_0, since sample size $n = 50$ is large, by Central Limit Theorem, $Z = \dfrac{\bar{X} - 100}{10/\sqrt{50}} \sim N(0,1)$ approx. Reject H_0 if $p - value \leq 0.05$. Calculations: $\bar{x} = 103.4$ $p - value = 0.0162$ Conclusion: Since $p - value < 0.05$, we reject H_0 and conclude that there is significant evidence at 5% level of significance that the process is not in control.
10(ii)	Reject H_0 is $\lvert z_{calc} \rvert \geq 1.960$ For H_0 to be rejected, $\left\lvert \dfrac{\bar{x} - 100}{10/\sqrt{50}} \right\rvert \geq 1.95996$ $\Rightarrow \bar{x} \leq 100 - 1.95996\left(\dfrac{10}{\sqrt{50}}\right)$ or $\bar{x} \geq 100 + 1.95996\left(\dfrac{10}{\sqrt{50}}\right)$ $\Rightarrow \bar{x} \leq 97.228$ or $\bar{x} \geq 102.772$ Thus the required range of values of $\bar{x}$ is $0 < \bar{x} \leq 97.2$ or $\bar{x} \geq 102.8$.

Qn	
10(iii)	$\bar{y}=\frac{4164}{40}=104.1$ $\Sigma(y-100)=4164-4000=164$ $s^2=\frac{1}{39}\left[\Sigma(y-100)^2-\frac{\left(\Sigma(y-100)\right)^2}{40}\right]$ $=\frac{1}{39}\left[9447-\frac{164^2}{40}\right]$ $=\frac{43873}{195}=224.9897$
10(iv)	The standard deviation may have changed due to the wear out of mechanical parts as well.
10(v)	To test : $H_0: \mu=100$ $H_1: \mu\neq 100$ Level of Significance: 4% Under H_0, since sample size $n=40$ is large, by Central Limit Theorem, $Z=\frac{\bar{Y}-100}{S/\sqrt{40}} \sim N(0,1)$ approx. Reject H_0 if $p-value \leq 0.04$. Calculations: $\bar{x}=104.1, s^2=224.9897$ $p-value=0.0839$ Conclusion: Since $p-value>0.04$, we do not reject H_0 and conclude that there is insignificant evidence at 4% level of significance that the process is not in control.