

## Sl: Dosraniad Poisson

### Graef 2005

③  $X \sim \text{Po}(4)$

(a)  $P(X < 6) = P(X \leq 5)$   
 $= 0.7851$

(b)  $P(X = 3) = P(X \leq 3) - P(X \leq 2)$   
 $= 0.4335 - 0.2381$   
 $= 0.1954$

### Itaf 2005

④  $X \sim \text{Po}(15)$

(a) (i)  $P(X = 10)$

Heb tablau

$$P(X = 10) = \frac{e^{-15} 15^{10}}{10!}$$

$$= 0.0486 \text{ i 4 lle degol}$$

Hefo tablau

$$P(X = 10) = P(X \leq 10) - P(X \leq 9)$$
$$= 0.1185 - 0.0699$$

$$= 0.0486$$

(ii)  $P(X < 12) = P(X \leq 11)$ .

(Heb tablau: angen cyfrifo  $P(X=0) + P(X=1) + \dots + P(X=11)$ .)

Hefo tablau:  $P(X \leq 11) = 0.1848$

(b)  $P(X > 20) = 1 - P(X \leq 20)$   
 $= 1 - 0.9170$   
 $= 0.0830$

(c) Mae angen  $P(X \leq n) \geq 0.99$

Yn edrych ar y tabl (cobfn  $m=15$ ),

rhaid bod  $n$  o leiaf 25 i sicrhau hyn.

Graef 2006

③  $X \sim \text{Po}(4)$

(a)  $\text{Var}(X) = 4$

Gwyriad safonol  $(X) = \sqrt{4}$   
 $= 2$

(b)  $P(X=3)$

Heb tablau

$$P(X=3) = e^{-4} \frac{4^3}{3!}$$

$$= 0.1954 \text{ i } 4 \text{ lle degol}$$

Hefo tablau

$$P(X=3) = P(X \leq 3) - P(X \leq 2)$$

$$= 0.4335 - 0.2381$$

$$= 0.1954$$

(ii)  $P(2 \leq X \leq 6)$

(Heb tablau: Arngyfnir  $P(X=2) + P(X=3) + \dots + P(X=6)$ .)

Hefo tablau:  $P(2 \leq X \leq 6) = P(X \leq 6) - P(X \leq 1)$

$$= 0.8893 - 0.0916$$

$$= 0.7977$$

(c)  $C = 5 + 4X$

$$E(C) = 5 + 4E(X)$$

$$E(C) = 5 + 4 \times 4$$

$$E(C) = 21$$

$$\text{Var}(C) = 4^2 \text{Var}(X)$$

$$\text{Var}(C) = 16 \times 4$$

$$\text{Var}(C) = 64$$

Gwyriad safonol  $(C) = \sqrt{64}$   
 $= 8$

## Haf 2006

③  $X \sim \text{Po}(4)$   
 $Y = 2X + 8$

(a)  $E(Y) = 2E(X) + 8$        $\text{Var}(Y) = 2^2 \times \text{Var}(X)$

$E(Y) = 2 \times 4 + 8$        $\text{Var}(Y) = 4 \times 4$

$E(Y) = 16$        $\text{Var}(Y) = 16$

Felly mae cyfwrdd ac amrywiad  $Y$  yn hafal.

(b) Gall  $X$  gymryd gwerthoedd  $0, 1, 2, 3, \dots$

Gall  $Y$  ddim ond gymryd gwerthoedd  $8, 10, 12, 14, \dots$

(nid  $0, 1, 2, \dots$ ) felly nid yw yn ddosraniad Poisson.

④ (a)  $X \sim \text{Po}(12)$

(i)  $P(X > 10) = P(X \geq 11)$   
 $= 1 - P(X \leq 10)$   
 $= 1 - 0.3472$   
 $= 0.6528$

(ii)  $P(X = 15) = P(X \leq 15) - P(X \leq 14)$   
 $= 0.8444 - 0.7720$   
 $= 0.0724$

(b)  $X \sim \text{Po}(6.3)$

(i)  $P(X = 5) = \frac{e^{-6.3} 6.3^5}{5!}$   
 $= 0.1519$  i 4 lle degol

(ii)  $P(X < 3) = P(X = 0) + P(X = 1) + P(X = 2)$   
 $= \frac{e^{-6.3} 6.3^0}{0!} + \frac{e^{-6.3} 6.3^1}{1!} + \frac{e^{-6.3} 6.3^2}{2!}$   
 $= e^{-6.3} \left( 1 + 6.3 + \frac{6.3^2}{2} \right)$   
 $= 0.0498$  i 4 lle degol.

Graef 2007

⑧  $X \sim \text{Po}(\mu)$

(a)  $X \sim \text{Po}(3.75)$

$$P(X=3) = \frac{e^{-3.75} 3.75^3}{3!}$$

$$= 0.2067 \text{ i 4 lle degol}$$

(b) (i)  $X \sim \text{Po}(2.4)$

$$P(X \geq 5) = 1 - P(X \leq 4)$$

$$= 1 - 0.904$$

[o dablau]

$$= 0.0959$$

(ii)  $X \sim \text{Po}(\mu)$

$$P(X \geq 5) = 0.2194$$

$$1 - P(X \leq 4) = 0.2194$$

$$1 - 0.2194 = P(X \leq 4)$$

$$P(X \leq 4) = 0.7806$$

Yn edrych ar y tablau, mae  $P(X \leq 4) = 0.7806$

yn ymddangos yn y cotofn ble mae  $\mu = 3.2$

(c)  $X \sim \text{Po}(0.6)$

$$P(\text{Dim gwall ar un tudalen}) = P(X=0)$$

$$= \frac{e^{-0.6} \times 0.6^0}{0!}$$

$$= e^{-0.6} \times \frac{1}{1}$$

$$= e^{-0.6}$$

$$P(\text{Dim gwall ar } n \text{ tudalen}) = P(\text{dim gwall ar dudalen 1}) \times$$

$$P(\text{dim gwall ar dudalen 2}) \times \dots \times$$

$$P(\text{dim gwall ar dudalen } n)$$

$$= \underbrace{e^{-0.6} \times e^{-0.6} \times \dots \times e^{-0.6}}_{n \text{ gwaith}}$$

$$= (e^{-0.6})^n$$

$$= e^{-0.6n}$$

(ii) Rydym angen  $e^{-0.6n} < 0.01$

$$\ln(e^{-0.6n}) < \ln(0.01)$$

$$-0.6n < \ln(0.01)$$

$$n > \frac{\ln(0.01)}{-0.6}$$

$$n > 7.675283643\dots$$

Felly rhaid i n fod o leiaf 8.

Haf 2007

②  $X \sim \text{Po}(4.5)$

(a) (i)  $P(X=5) = \frac{e^{-4.5} \times 4.5^5}{5!}$

$$= 0.1708 \text{ i } 4 \text{ lle degol}$$

(ii)  $P(X \leq 2) = P(X=0) + P(X=1) + P(X=2)$

$$= \frac{e^{-4.5} \times 4.5^0}{0!} + \frac{e^{-4.5} \times 4.5^1}{1!} + \frac{e^{-4.5} \times 4.5^2}{2!}$$

$$= e^{-4.5} \left( 1 + 4.5 + \frac{4.5^2}{2} \right)$$

$$= 0.1736 \text{ i } 4 \text{ lle degol}$$

(b)  $P(3 \leq X \leq 7) = P(X \leq 7) - P(X \leq 2)$

$$= 0.9134 - 0.1736$$

$$= 0.7398$$

Graef 2008

③  $X \sim Po(0.95)$

(a) (i)  $P(X=0) = \frac{e^{-0.95} \times 0.95^0}{0!}$

$= 0.3867$  i 4 lle degol

(ii)  $P(X=3 \text{ neu } 4) = P(X=3) + P(X=4)$

$= \frac{e^{-0.95} \times 0.95^3}{3!} + \frac{e^{-0.95} \times 0.95^4}{4!}$

$= 0.0684$  i 4 lle degol.

(b) (i)  $P(\text{dim gwallau yn yr adroddiad})$

$= P(\text{dim gwall ar dudalen 1}) \times P(\text{dim gwall ar dudalen 2})$   
 $\times P(\text{dim gwall ar dudalen 3}) \times P(\text{dim gwall ar dudalen 4})$   
 $= 0.3867 \times 0.3867 \times 0.3867 \times 0.3867$

$= 0.0224$  i 4 lle degol

(ii)  $P(\text{gwall cyntaf ar y drydedd dudalen})$

$= P(\text{dim gwall ar dudalen 1}) \times P(\text{dim gwall ar dudalen 2})$   
 $\times P(\text{0 leiaf un gwall ar dudalen 3})$   
 $= 0.3867 \times 0.3867 \times (1 - 0.3867)$

$= 0.0917$  i 4 lle degol.

Haf 2008

④ (a)  $X \sim Po(2.4)$

$P(3 \leq X \leq 6) = P(X \leq 6) - P(X \leq 2)$

$= 0.9884 - 0.5697$

$= 0.4187$

(b)  $X \sim Po(3.25)$

(i)  $P(X=5) = \frac{e^{-3.25} \times 3.25^5}{5!}$

$= 0.1172$  i 4 lle degol

$$\begin{aligned}
 \text{(ii) } P(X < 3) &= P(X=0) + P(X=1) + P(X=2) \\
 &= \frac{e^{-3.25} \times 3.25^0}{0!} + \frac{e^{-3.25} \times 3.25^1}{1!} + \frac{e^{-3.25} \times 3.25^2}{2!} \\
 &= e^{-3.25} \left( 1 + 3.25 + \frac{3.25^2}{2} \right) \\
 &= 0.3696 \text{ i 4 lle dego!}
 \end{aligned}$$

Graef 2009

③ (a)  $X \sim \text{Po}(2.75)$

(i)  $P(X=4) = \frac{e^{-2.75} \times 2.75^4}{4!}$

$= 0.1523$

(ii)  $P(X > 2) = 1 - P(X \leq 2)$

$= 1 - P(X=0) - P(X=1) + P(X=2)$

$= 1 - \frac{e^{-2.75} \times 2.75^0}{0!} - \frac{e^{-2.75} \times 2.75^1}{1!} - \frac{e^{-2.75} \times 2.75^2}{2!}$

$= 1 - e^{-2.75} \left( 1 + 2.75 + \frac{2.75^2}{2} \right)$

$= 1 - 0.4814567047 \dots$

$= 0.5185 \text{ i 4 lle dego!}$

(b)  $X \sim \text{Po}(3)$

(i)  $P(X < 5) = P(X \leq 4)$

$= 0.8153$

(ii)  $P(X=3) = P(X \leq 3) - P(X \leq 2)$

$= 0.6472 - 0.4232$

$= 0.2240$

$$(4) X \sim \text{Po}(4)$$

$$E(X) = 4 \quad \text{Var}(X) = 4$$

$$Y = 3X - 7$$

$$(a) E(Y) = 3E(X) - 7$$

$$E(Y) = 3 \times 4 - 7$$

$$E(Y) = 5$$

$$\text{Var}(Y) = 3^2 \times \text{Var}(X)$$

$$\text{Var}(Y) = 9 \times 4$$

$$\text{Var}(Y) = 36$$

$$(b) P(Y > 0) = P(3X - 7 > 0)$$

$$= P(3X > 7)$$

$$= P(X > \frac{7}{3})$$

$$= P(X \geq 3)$$

$$= 1 - P(X \leq 2)$$

$$= 1 - 0.2381$$

$$= 0.7619$$

[o dablau]

Haf 2009

$$(4) X \sim \text{Po}(0.6t), \quad t \text{ awr}$$

$$(a) X \sim \text{Po}(0.6 \times 4 = 2.4)$$

$$(i) P(X=3)$$

Heb dablau

$$P(X=3) = \frac{e^{-2.4} \times 2.4^3}{3!}$$

$$= 0.2090 \text{ ; 4 lile degol}$$

Hefo Eablau

$$P(X=3) = P(X \leq 3) - P(X \leq 2)$$

$$= 0.7787 - 0.5697$$

$$= 0.2090$$

$$(ii) P(X \geq 3) = 1 - P(X \leq 2)$$

Heb dablau

$$1 - P(X \leq 2) = 1 - P(X=0) - P(X=1) - P(X=2)$$

$$= 1 - e^{-2.4} \times \frac{2.4^0}{0!} - e^{-2.4} \times \frac{2.4^1}{1!} - e^{-2.4} \times \frac{2.4^2}{2!}$$

$$= 1 - e^{-2.4} \left( 1 + 2.4 + \frac{2.4^2}{2} \right)$$

$$= 1 - 0.5697087467 \dots$$

$$= 0.4303 \text{ ; 4 lile degol}$$

$$\text{Itefo tablau: } 1 - P(X \leq 2) = 1 - 0.5697 \\ = 0.4303$$

$$(b) X \sim \text{Po}(0.6t)$$

$$P(X=0) = 0.5$$

$$\frac{e^{-0.6t} \times (0.6t)^0}{0!} = 0.5$$

$$e^{-0.6t} = 0.5$$

$$\ln(e^{-0.6t}) = \ln(0.5)$$

$$-0.6t = \ln(0.5)$$

$$t = \frac{\ln(0.5)}{-0.6}$$

$$t = 1.155245301 \text{ awr}$$

$$(t = 1 \text{ awr } 9 \text{ munud } 18.88 \text{ eiliad})$$

[Ni cheir marciau llawn  
am geisio defnyddio'r  
tablau i ateb y cwestiwn.]

↳ Botwm 0 > ) argyfyriannell

Graef 2010

$$(7) X \sim \text{Po}(1.2)$$

$$(a) (i) P(X \geq 3) = 1 - P(X \leq 2)$$

$$\text{Iteb tablau: } 1 - P(X \leq 2) = 1 - P(X=0) - P(X=1) - P(X=2)$$

$$= 1 - e^{-1.2} \frac{1.2^0}{0!} - e^{-1.2} \frac{1.2^1}{1!} - e^{-1.2} \frac{1.2^2}{2!}$$

$$= 1 - e^{-1.2} \left( 1 + 1.2 + \frac{1.2^2}{2} \right)$$

$$= 1 - 0.8794870988 \dots$$

$$= 0.1205 \text{ i } 4 \text{ lle degol}$$

$$\text{Itefo tablau: } 1 - P(X \leq 2) = 1 - 0.8795$$

$$= 0.1205$$

$$(ii) P(X=0)$$

Heb dablau

$$P(X=0) = \frac{e^{-1.2} \times 1.2^0}{0!}$$

$$= 0.3012 \text{ i 4 lle degol}$$

Hefo tablau

$$P(X=0) = P(X \leq 0) \\ = 0.3012$$

$$(b) P(X \geq 3 | X \geq 1) = \frac{P(X \geq 3 \cap X \geq 1)}{P(X \geq 1)}$$

$$= \frac{P(X \geq 3)}{P(X \geq 1)}$$

$$= \frac{P(X \geq 3)}{1 - P(X=0)}$$

$$= \frac{0.1205}{1 - 0.3012}$$

$$= 0.1724 \text{ i 4 lle degol}$$

$$= 0.1724 \text{ i 4 lle degol}$$

$$(c) P(X=0, X=0, X \geq 1) = P(X=0) \times P(X=0) \times P(X \geq 1) \\ = 0.3012 \times 0.3012 \times (1 - 0.3012) \\ = 0.0634 \text{ i 4 lle degol}$$

Haf 2010

$$(3) X \sim Po(0.1t)$$

$$(a) x \sim Po(0.1 \times 60 = 6)$$

$$(i) P(X=3)$$

Heb dablau

$$P(X=3) = \frac{e^{-6} \times 6^3}{3!}$$

$$= 0.0892 \text{ i 4 lle degol}$$

Hefo tablau

$$P(X=3) = P(X \leq 3) - P(X \leq 2)$$

$$= 0.1512 - 0.0620$$

$$= 0.0892$$

$$(ii) P(X < 5) = P(X \leq 4)$$

(Heb tablau: angen cyfrifo  $P(X=0) + P(X=1) + \dots + P(X=4)$ )

Hefo tablau:  $P(X \leq 4) = 0.2851$

$$(b) X \sim Po(0.1t)$$

$$P(X=0) = 0.25$$

$$e^{-0.1t} \times \frac{(0.1t)^0}{0!} = 0.25$$

$$e^{-0.1t} = 0.25$$

$$\ln(e^{-0.1t}) = \ln(0.25)$$

$$-0.1t = \ln(0.25)$$

$$t = \frac{\ln(0.25)}{-0.1}$$

$$t = 13.86294361 \text{ munud}$$

$$t \approx 13.86 \text{ i 2 le degol}$$

[Nid gwir marciau llawn yn cael eu rhoi am gersio defnyddiwr tablau i ateb y cwestiwn.]

### Gaeaf 2011

$$(5) X \sim Po(15)$$

(a) (i)  $P(X=8)$

Heb tablau

$$P(X=8) = \frac{e^{-15} \times 15^8}{8!}$$

$$= 0.0194 \text{ i 4 lle degol.}$$

Hefo tablau

$$P(X=8) = P(X \leq 8) - P(X \leq 7)$$

$$= 0.0374 - 0.0180$$

$$= 0.0194$$

(ii)  $P(10 \leq X \leq 20)$

(Heb tablau: angen cyfrifo  $P(X=10) + P(X=11) + \dots + P(X=20)$ .)

Hefo tablau:  $P(10 \leq X \leq 20) = P(X \leq 20) - P(X \leq 9)$

$$= 0.9170 - 0.0699$$

$$= 0.8471$$

(b) (i)  $Y = 8X - 50$

(ii)  $E(Y) = 8E(X) - 50$

$E(Y) = 8 \times 15 - 50$

$E(Y) = \pounds 70$

$\text{Var}(Y) = 8^2 \times \text{Var}(X)$

$\text{Var}(Y) = 64 \times 15$

$\text{Var}(Y) = \pounds 960$

Haf 2011

②  $X \sim \text{Po}(4)$   
 $Y = aX + b$

(a)  $E(Y) = 16$

$aE(X) + b = 16$

$4a + b = 16$

$\text{Var}(Y) = 16$

$a^2 \text{Var}(X) = 16$

$4a^2 = 16$

$a^2 = 4$

$a = \pm\sqrt{4}$

$a = \pm 2$

ond mae  $a, b$  yn gysonion positif

felly  $a = 2$

$4 \times 2 + b = 16$

$8 + b = 16$

$b = 8$

(b) Mae  $X$  yn cymryd y gwerthoedd  $0, 1, 2, 3, 4, \dots$ .

Gyda  $Y = 2X + 8$ , mae  $Y$  yn cymryd y gwerthoedd

$8, 10, 12, 14, \dots$  yn unig. Gan nad yw  $Y$  yn

cymryd yr holl gyfannrifau positif (ee.  $1, 2, 3$ )

nid yw  $Y$  yn ddosraniad Poisson.

$$④ X \sim Po(0.2t)$$

$$(a) (i) X \sim Po(0.2 \times 60 = 12)$$

$$P(X=10)$$

Iteb dablau

$$P(X=10) = \frac{e^{-12} \times 12^{10}}{10!}$$

$$= 0.1048 \text{ (i 4 lle degol)}$$

Itefo tablau

$$\begin{aligned} P(X=10) &= P(X \leq 10) - P(X \leq 9) \\ &= 0.3472 - 0.2424 \\ &= 0.1048 \end{aligned}$$

$$(ii) X \sim Po(0.2 \times 30 = 6)$$

$$P(X > 5) = 1 - P(X \leq 5)$$

(Iteb dablau: angen cyfrifo  $1 - P(X=0) - P(X=1) - \dots - P(X=5)$ .)

Itefo tablau:  $1 - P(X \leq 5)$

$$= 1 - 0.4457$$

$$= 0.5543$$

$$(b) X \sim Po(0.2t)$$

$$P(X=0) = 0.03$$

$$\frac{e^{-0.2t} \times (0.2t)^0}{0!} = 0.03$$

$$e^{-0.2t} = 0.03$$

$$\ln(e^{-0.2t}) = \ln(0.03)$$

$$-0.2t = \ln(0.03)$$

$$t = \frac{\ln(0.03)}{-0.2}$$

$$t = 17.53278949$$

$$t = 17.53 \text{ munud (i 2 lle degol)}$$

[Nicheir marciau llawn  
am geisio defnyddio  
tablau i ateb y  
cwestiun yma.]

Graef 2012

②  $X \sim \text{Po}(5)$

$$Y = 2X + 3$$

$$E(Y) = 2E(X) + 3$$

$$E(Y) = 2 \times 5 + 3$$

$$E(Y) = 13$$

$$\text{Var}(Y) = 2^2 \times \text{Var}(X)$$

$$\text{Var}(Y) = 4 \times 5$$

$$\text{Var}(Y) = 20$$

⑥  $X \sim \text{Po}(3.6)$

(a) (i)  $P(X=5) = \frac{e^{-3.6} \times 3.6^5}{5!}$

$$= 0.1377 \text{ i 4 lle decimal}$$

(ii)  $P(X < 3) = P(X \leq 2)$

$$= P(X=0) + P(X=1) + P(X=2)$$

$$= \frac{e^{-3.6} \times 3.6^0}{0!} + \frac{e^{-3.6} \times 3.6^1}{1!} + \frac{e^{-3.6} \times 3.6^2}{2!}$$

$$= e^{-3.6} \left( 1 + 3.6 + \frac{3.6^2}{2} \right)$$

$$= 0.3027 \text{ i 4 lle decimal}$$

(b)  $P(3 \leq X \leq 7) = P(X \leq 7) - P(X \leq 2)$

$$= 0.9692 - 0.3027$$

$$= 0.6665$$

## Haf 2012

⑦  $X \sim \text{Po}(12)$

(a) (i)  $P(X=10)$

Heb tablau

$$P(X=10) = \frac{e^{-12} \times 12^{10}}{10!}$$

$$= 0.1048 \text{ i 4 lle degol}$$

Hefo tablau

$$\begin{aligned} P(X=10) &= P(X \leq 10) - P(X \leq 9) \\ &= 0.3472 - 0.2424 \\ &= 0.1048 \end{aligned}$$

(ii)  $P(X > 10) = 1 - P(X \leq 10)$

(Heb tablau: angen cyfrifo  $1 - P(X=0) - P(X=1) - \dots - P(X=10)$ .)

Hefo tablau:  $1 - P(X \leq 10)$

$$= 1 - 0.3472$$

$$= 0.6528$$

(b) Angen  $P(X \leq n) \geq 0.95$ .

Yn edrych ar y tablau (y golofn  $m=12$ ),

mae angen i  $n$  fod o leiaf 18 i sicrhau

bod  $P(X \leq n) \geq 0.95$ . Felly nifer minimum y jariau yw 18.

## Graef 2013

④  $X \sim \text{Po}(0.1E)$

(a) (i)  $X \sim \text{Po}(0.1 \times 60 = 6)$

$$P(X=4)$$

Heb tablau

$$P(X=4) = \frac{e^{-6} \times 6^4}{4!}$$

$$= 0.1339 \text{ i 4 lle degol}$$

Hefo tablau

$$P(X=4) = P(X \leq 4) - P(X \leq 3)$$

$$= 0.2851 - 0.1512$$

$$= 0.1339$$

(ii)  $P(2 \leq X \leq 8) = P(X \leq 8) - P(X \leq 1)$

$$= 0.8472 - 0.0174$$

$$= 0.8298$$

(Heb tablau: Angen cyfrifo  $P(X=2) + P(X=3) + \dots + P(X=8)$ .)

$$(b) X \sim Po(0.1 \times 120 = 12)$$

$$E(X) = 12$$

$$Var(X) = 12$$

$$Var(X) = E(X^2) - [E(X)]^2$$

$$12 = E(X^2) - 12^2$$

$$12 + 12^2 = E(X^2)$$

$$E(X^2) = 156$$

Haf 2013

$$(8) X \sim Po(5t)$$

$$(a) X \sim Po(5 \times 1 = 5)$$

$$P(X=7) = \frac{e^{-5} \times 5^7}{7!}$$

$$= 0.1044 \text{ i } 4 \text{ lle degol}$$

$$(b) P(X=7 \text{ (rhwyng 9 a 10)} \mid X=10 \text{ (rhwyng 9 ac 11)})$$

$$= \frac{P(X=7 \text{ (rhwyng 9 a 10)} \cap X=10 \text{ (rhwyng 9 ac 11)})}{P(X=10 \text{ (rhwyng 9 ac 11)})}$$

$$= \frac{P(X=7 \text{ (rhwyng 9 a 10)}) \times P(X=3 \text{ (rhwyng 10 ac 11)})}{P(X=10 \text{ (rhwyng 9 ac 11)})}$$

$$= \frac{\left( \frac{e^{-5} \times 5^7}{7!} \right) \times \left( \frac{e^{-5} \times 5^3}{3!} \right)}{\left( \frac{e^{-10} \times 10^{10}}{10!} \right)}$$

$$= \frac{15}{128}$$

$$(= 0.1171875)$$

Si Graef 2014

⑧  $X \sim Po(15)$

$$\begin{aligned} \text{(a) (i) } P(X=12) &= e^{-15} \frac{15^{12}}{12!} && = P(X \leq 12) - P(X \leq 11) \\ & && = 0.2676 - 0.1848 \\ &= 0.0829 \text{ i 4 lle degol} && = 0.0828 \end{aligned}$$

HEB TABLAU

HEFO TABLAU

(ii)  $P(X \leq 19) = 0.8752$  o dablau.

Er mwyn gwerthu'r 20 papur newydd rhaid i'r galw am y papurau fod yn fwy na neu'n hafal i 20. Rydym felly angen  $P(X \geq 20) = 1 - 0.8752 = \underline{0.1248}$

(b) Rydym angen darganfod rhif 'y' fel bod  $P(X \leq y) \geq 0.99$ .

Yn edrych ar y tablau, mae

$$P(X \leq 24) = 0.9888$$

$$P(X \leq 25) = 0.9938.$$

Felly rhaid i'r siopwr brynu 25 o bapurau newydd yr uwgorn er mwyn bod y tebygolrwydd y bydd yn medru curdd o'r galw o leiaf 0.99.

Si Haf 2014

④  $X \sim Po(0.1t)$

(a)  $t = 15$  munud felly  $X \sim Po(0.1 \times 15)$   
 $X \sim Po(1.5)$

$$P(X=2) = e^{-1.5} \times \frac{1.5^2}{2!}$$

$P(X=2) = 0.2510$  ; 4 lle degol.

(b)  $P(X > 2) = 1 - P(X \leq 2)$   
 $= 1 - P(X=2) - P(X=1) - P(X=0)$ .

$$P(X=1) = e^{-1.5} \times \frac{1.5^1}{1!}$$

$= 0.3347$   
i 4 lle degol

$$P(X=0) = e^{-1.5} \times \frac{1.5^0}{0!}$$

$= 0.2231$   
i 4 lle degol

Felly  $P(X > 2) = 1 - 0.2510 - 0.3347 - 0.2231$   
 $P(X > 2) = 0.191$  ; 3 lle degol.

SI Haf 2015

4)  $X \sim Po(10)$

a) (i)  $P(X=9)$

Heb tablau

$$P(X=9) = \frac{e^{-10} 10^9}{9!}$$

$= 0.1251$  i 4 lle degol

Hefo tablau

$$P(X=9) = P(X \leq 9) - P(X \leq 8)$$
$$= 0.4579 - 0.3328$$

$= 0.1251$

(ii)  $P(X < 12) = P(X \leq 11)$ .

(Heb tablau: angen cyfrifo  $P(X=0) + P(X=1) + \dots + P(X=11)$ .)

Hefo tablau:  $P(X \leq 11) = \underline{0.6968}$

b)  $P(X \geq n) = 1 - P(X < n)$   
 $= 1 - P(X \leq n-1)$

Rydym angen  $P(X \leq n-1)$  fod yn fwy na  $1 - 0.01$   
 $= 0.99$

Yn ôl y tablau, mae  $P(X \leq 17) = 0.9857$   
 $P(X \leq 18) = 0.9928$

Felly  $n-1 = 18$  ac felly  $n = 19$ .

SI Itaf 2016

③  $X \sim \text{Po}(2)$

$$Y = aX + b$$

$$a > 0, b > 0$$

a)  $E(Y) = aE(X) + b$   
 $8 = a(2) + b$   
 $8 = 2a + b$

$$\text{Var}(Y) = a^2 E(X)$$

$$8 = a^2(2)$$

$$8 = 2a^2$$

$$4 = a^2$$

$$\pm 2 = a$$

Gran fod  $a > 0$  rhaid bod  $a = 2$

$$8 = 2(2) + b$$

$$8 - 4 = b$$

$$\underline{b = 4}$$

(Felly  $Y = 2X + 4$ )

- b) OS yw cymedr ac amrywiad dosraniad yn hafal, nid oes raid i'r dosraniad fod yn un Poisson. Yn yr achos yma ( $Y = 2X + 4$ ), nid yw  $Y$  yn ddosraniad Poisson gan nad oes gwerthoedd o  $X$  yn bodoli fel bod  $Y$  yn gallu bod yn  $0, 1, 2, 3$ .

Hynny yw, mae  $X$  yn cymryd gwerthoedd  $0, 1, 2, 3, \dots$   
 fel bod  $Y$  yn cymryd gwerthoedd  $4, 6, 8, 10, \dots$

Er mwyn  $i$   $Y$  gymryd y gwerth  $0$  (er enghraifft) byddai raid i  $X$  fod yn  $-2$ , sydd ddim yn bosib.

$$\left( \begin{array}{l} Y = 2X + 4 \\ 0 = 2X + 4 \\ -4 = 2X \\ X = -2 \end{array} \right)$$

51 Haf 2016

(5)  $X \sim Po(0.2t)$

a) (i)  $t = 30$  felly  $X \sim Po(0.2 \times 30)$   
 $X \sim Po(6)$

$$P(X=5) = e^{-6} \frac{6^5}{5!}$$

$$= 0.160623141$$

$$= 0.1606 \text{ i 4 lle degol}$$

(ii)  $P(X > 3) = 1 - P(X \leq 3)$

$$= 1 - P(X=0) - P(X=1) - P(X=2) - P(X=3)$$

$$= 1 - \frac{e^{-6} \times 6^0}{0!} - \frac{e^{-6} \times 6^1}{1!} - \frac{e^{-6} \times 6^2}{2!} - \frac{e^{-6} \times 6^3}{3!}$$

$$= 1 - e^{-6}(1 + 6 + 18 + 36)$$

$$= 0.8487961172$$

$$= 0.8488 \text{ i 4 lle degol}$$

b)  $X \sim Po(0.2t)$

$$P(X=5) = 0.0602$$

$$P(X \leq 5) - P(X \leq 4) = 0.0602$$

Yn defnyddio'r tablau, os yw  $0.2t = 2.4$

yma mae  $P(X \leq 5) = 0.9643$ ,  $P(X \leq 4) = 0.9041$

fel bod  $P(X \leq 5) - P(X \leq 4) = 0.9643 - 0.9041$

$$= 0.0602 \quad \checkmark$$

Felly  $0.2t = 2.4$

$$t = \underline{\underline{12 \text{ munud}}}$$