

SI: Dosraniad Binomial

Graef 2005

② $X \sim B(48, 0.25)$

$$E(X) = np$$

$$= 48 \times 0.25$$

$$= 12$$

$$\text{Var}(X) = npq$$

$$= 48 \times 0.25 \times 0.75$$

$$= 9$$

$$Y = 2X - 1$$

$$E(Y) = 2E(X) - 1$$

$$= 2 \times 12 - 1$$

$$= 23$$

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

$$= 4 \times 9$$

$$= 36$$

Cymedr Y yw 23. Gwyriad Safonol Y yw $\sqrt{36} = 6$.

⑤ $X \sim B(550, 0.007)$

n yn uchel, p yn isel felly $X \approx \text{Po}(np)$

$$X \approx \text{Po}(3.85)$$

$$(a) P(X=4) = e^{-3.85} \frac{3.85^4}{4!}$$

$$= 0.1948 \quad \text{i 4 lle degol}$$

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

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

$$= 1 - e^{-3.85} \frac{3.85^2}{2!} - e^{-3.85} \frac{3.85^1}{1!} - e^{-3.85} \frac{3.85^0}{0!}$$

$$= 1 - e^{-3.85} \left(\frac{3.85^2}{2!} + \frac{3.85^1}{1!} + \frac{3.85^0}{0!} \right)$$

$$= 0.7391 \quad \text{i 4 lle degol}$$

⑦ $X \sim B(20, 0.6)$

(a) Heb tablau:

$$\begin{aligned} P(X=12) &= \binom{20}{12} 0.6^{12} (1-0.6)^{20-12} \\ &= {}^{20}C_{12} 0.6^{12} 0.4^8 \\ &= 0.1797 \quad \text{i 4 lle degol} \end{aligned}$$

Itefo tablau:

X nifer y cywion benyw
 $X \sim B(20, 0.6)$

Y nifer y cywion gwryw
 $Y \sim B(20, 0.4)$

$$\begin{aligned} P(X=12) &= P(Y=8) \\ &= P(Y \leq 8) - P(Y \leq 7) \\ &= 0.5956 - 0.4159 \\ &= 0.1797 \end{aligned}$$

(b) Heb tablau:

$$\begin{aligned} P(9 \leq X \leq 15) &= P(X=9) + P(X=10) + \dots + P(X=15) \\ &= {}^{20}C_9 0.6^9 0.4^{11} + {}^{20}C_{10} 0.6^{10} 0.4^{10} \\ &\quad + {}^{20}C_{11} 0.6^{11} 0.4^9 + {}^{20}C_{12} 0.6^{12} 0.4^8 \\ &\quad + {}^{20}C_{13} 0.6^{13} 0.4^7 + {}^{20}C_{14} 0.6^{14} 0.4^6 \\ &\quad + {}^{20}C_{15} 0.6^{15} 0.4^5 \\ &= 0.8925 \quad \text{i 4 lle degol} \end{aligned}$$

Itefo tablau:

$$\begin{aligned} P(9 \leq X \leq 15) &= P(5 \leq Y \leq 11) \\ &= P(Y \leq 11) - P(Y \leq 4) \\ &= 0.9435 - 0.0510 \\ &= 0.8925 \end{aligned}$$

Haf 2005

⑥ (a) (i) $X \sim B(10, \frac{1}{6})$

(ii) $E(X) = np$
 $= 10 \times \frac{1}{6}$
 $= \frac{5}{3}$

$Var(X) = npq$
 $= 10 \times \frac{1}{6} \times \frac{5}{6}$
 $= \frac{25}{18}$

(iii) $P(X \leq 2) = P(X=0) + P(X=1) + P(X=2)$
 $= \binom{10}{0} \left(\frac{1}{6}\right)^0 \left(\frac{5}{6}\right)^{10-0} + \binom{10}{1} \left(\frac{1}{6}\right)^1 \left(\frac{5}{6}\right)^{10-1}$
 $+ \binom{10}{2} \left(\frac{1}{6}\right)^2 \left(\frac{5}{6}\right)^{10-2}$
 $= {}^{10}C_0 \times \left(\frac{5}{6}\right)^{10} + {}^{10}C_1 \times \frac{1}{6} \times \left(\frac{5}{6}\right)^9 + {}^{10}C_2 \times \left(\frac{1}{6}\right)^2 \times \left(\frac{5}{6}\right)^8$
 $= 0.7752 \quad \text{i 4 lle degol}$

(b) $Y \sim B(81, \frac{1}{36})$

n yn uchel a p yn isel felly $Y \approx Po(np)$

$Y \approx Po(2.25)$

$P(Y=4) = e^{-2.25} \frac{2.25^4}{4!}$

$= 0.1126 \quad \text{i 4 lle degol}$

Graef 2006

⑤ $X \sim B(n, p)$

$E(X) = 20$

$Var(X) = 4^2$

$np = 20 \quad \text{--- (1)}$

$npq = 16 \quad \text{--- (2)}$

Yn amnewid am np o (1) i (2): $(np)q = 16$

$20q = 16$

$q = \frac{16}{20}$

$q = 0.8$

Felly $p = 0.2$.

Yn amnewid yn ôl i (1): $np = 20$

$0.2n = 20$

$n = 100$

⑦ (a) $X \sim B(24, 0.05)$

$$P(X=2) = \binom{24}{2} 0.05^2 (1-0.05)^{24-2}$$

$$= {}^{24}C_2 \times 0.05^2 \times 0.95^{22}$$

$$= 0.2232 \text{ i 4 lle degol}$$

(b) $X \sim B(50, 0.05)$

$$P(3 \leq X \leq 5) = P(X \leq 5) - P(X \leq 2)$$

$$= 0.9622 - 0.5405$$

$$= 0.4217$$

(c) $X \sim B(120, 0.05)$
 n yn uchel, p yn isel felly $X \approx Po(np)$
 $X \approx Po(120 \times 0.05)$
 $X \approx Po(6)$

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

$$= 0.7440 \quad (\text{o dablau})$$

Haf 2006

⑥ (a) (i) $X \sim B(50, 0.2)$ Binomial
 (ii) $E(X) = np$ $Var(X) = npq$
 $= 50 \times 0.2$ $= 50 \times 0.2 \times 0.8$
 $= 10$ $= 8$
 Cymedr X yw 10 Gwyriad safonol X yw $\sqrt{8} = 2\sqrt{2}$
 (iii) $P(8 \leq X \leq 12) = P(X \leq 12) - P(X \leq 7)$
 $= 0.8139 - 0.1904$ [o dablau]
 $= 0.6235$

(b) $X \sim B(1000, 0.01)$
 n yn uchel, p yn isel felly $X \approx Po(np)$
 $X \approx Po(10)$

$$P(X < 10) = P(X \leq 9)$$

$$= 0.4579 \quad (\text{o dablau})$$

Gaeaf 2007

③ $X \sim B(n, 0.1)$

Cymedr = Gwyriad Safonol

$$np = \sqrt{npq}$$

$$n^2 p^2 = npq$$

$$n^2 (0.1)^2 = n(0.1)(0.9)$$

$$0.01 n^2 = 0.09 n$$

$$n^2 = 9n \quad (\text{lluosi efo } 100)$$

$$n^2 - 9n = 0$$

$$n(n-9) = 0$$

Unai $n=0$ neu $n-9=0$

$$n=9$$

Os yw $n=0$ nid oes unrhyw dreialon felly rhaid bod $n=9$.

Haf 2007

⑤ (a) $X \sim B(5, 0.4)$

Binomial

(ii) $E(X) = np$

$$= 5 \times 0.4$$

$$= 2$$

Cymedr X yw 2

$$\text{Var}(X) = npq$$

$$= 5 \times 0.4 \times 0.6$$

$$= 1.2$$

Gwyriad Safonol X yw $\sqrt{1.2} \approx 1.095$
i 3 lle degol

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

$$= 1 - 0.6826 \quad (\text{o dablau})$$

$$= 0.3174$$

(Heb dablau: $1 - P(X \leq 2) = 1 - P(X=2) - P(X=1) - P(X=0)$
 $= 1 - \binom{5}{2} 0.4^2 0.6^{5-2} - \binom{5}{1} 0.4^1 0.6^{5-1} - \binom{5}{0} 0.4^0 0.6^{5-0}$
 $= 1 - {}^5C_2 0.4^2 0.6^3 - {}^5C_1 0.4 \times 0.6^4 - {}^5C_0 \times 0.6^5$
 $= 0.31744.$)

$$(b) X \sim B(24, 0.05)$$

n yn uchel, p yn isel felly $X \approx Po(np)$

$$X \approx Po(24 \times 0.05)$$

$$X \approx Po(1.2)$$

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

$$= 0.8795 \quad (\text{o dablau}).$$

$$(\text{Heb dablau: } P(X \leq 2) = P(X=0) + P(X=1) + P(X=2))$$

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

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

$$= 0.8794870988 \dots$$

$$= 0.8795 \text{ i 4 lle degol.}$$

Graef 2008

$$(4) X \sim B(10, 0.3)$$

$$E(X) = np$$

$$= 10 \times 0.3$$

$$= 3$$

$$\text{Var}(X) = npq$$

$$= 10 \times 0.3 \times 0.7$$

$$= 2.1$$

$$(a) E(Y) = 3E(X) + 4$$

$$= 3 \times 3 + 4$$

$$= 13$$

$$(Y = 3X + 4)$$

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

$$= 9 \times 2.1$$

$$= 18.9$$

$$(c) P(Y=16) = P(3X+4=16)$$

$$= P(3X=12)$$

$$= P(X=4)$$

$$= \binom{10}{4} 0.3^4 (1-0.3)^{10-4}$$

$$= {}^{10}C_4 \times 0.3^4 \times 0.7^6$$

$$= 0.2001 \text{ i 4 lle degol.}$$

→ neu, efo tablau,

$$P(X=4)$$

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

$$= 0.8497 - 0.6496$$

$$= 0.2001$$

⑦ (a) $X \sim B(20, 0.3)$

(i) $P(X=8)$

Heb tablau

$$P(X=8) = \binom{20}{8} 0.3^8 (1-0.3)^{20-8}$$

$$= {}^{20}C_8 \times 0.3^8 \times 0.7^{12}$$

$$= 0.1144 \text{ i 4 lle degol}$$

Hefo tablau

$$P(X=8)$$

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

$$= 0.8867 - 0.7723$$

$$= 0.1144$$

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

$$= 1 - 0.4164 \text{ (o tablau)}$$

$$= 0.5836$$

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

(b) $X \sim B(1000, 0.01)$

n yn uchel, p yn isel Felly $X \approx Po(np)$
 $X \approx Po(1000 \times 0.01)$
 $X \approx Po(10)$

$$P(X < 9) = P(X \leq 8)$$

$$= 0.3328 \text{ (o tablau)}$$

Itaf 2008

⑦ $X \sim B(50, 0.2)$

(a) (i) $P(X=12)$

Heb tablau

$$P(X=12) = \binom{50}{12} 0.2^{12} (1-0.2)^{50-12}$$

$$= {}^{50}C_{12} \times 0.2^{12} \times 0.8^{38}$$

$$= 0.1033 \text{ i 4 lle degol}$$

Hefo tablau

$$P(X=12) = P(X \leq 12) - P(X \leq 11)$$

$$= 0.8139 - 0.7107$$

$$= 0.1032$$

(ii) $P(10 \leq X \leq 14)$

Iteb tablau

$$\begin{aligned} P(10 \leq X \leq 14) &= P(X=10) + P(X=11) + P(X=12) + P(X=13) + P(X=14) \\ &= \binom{50}{10} 0.2^{10} 0.8^{40} + \binom{50}{11} 0.2^{11} 0.8^{39} + \binom{50}{12} 0.2^{12} 0.8^{38} \\ &\quad + \binom{50}{13} 0.2^{13} 0.8^{37} + \binom{50}{14} 0.2^{14} 0.8^{36} \\ &= 0.4955375071 \dots \\ &= 0.4955 \text{ i 4 lle degol} \end{aligned}$$

Itefo tablau

$$\begin{aligned} P(10 \leq X \leq 14) &= P(X \leq 14) - P(X \leq 9) \\ &= 0.9393 - 0.4437 \\ &= 0.4956 \end{aligned}$$

(iii) Methu gwerthu, methu gwerthu, gwerthu

$$0.8 \times 0.8 \times 0.2$$

$$= 0.128$$

(b) $X \sim B(50, 0.2)$

$$\begin{aligned} E(X) &= np \\ &= 50 \times 0.2 \\ &= 10 \end{aligned}$$

$$\begin{aligned} \text{Var}(X) &= npq \\ &= 50 \times 0.2 \times 0.8 \\ &= 8 \end{aligned}$$

$$Y = 50X + 100$$

$$E(Y) = 50E(X) + 100$$

$$E(Y) = 50 \times 10 + 100$$

$$E(Y) = 600$$

$$\text{Var}(Y) = 50^2 \times \text{Var}(X)$$

$$= 2500 \times 8$$

$$= 20000$$

Cymedr ei gyflog yw £600.

Gwriad safonol ei gyflog yw $\sqrt{20000} \approx \pounds 141.42$

i'r geiniog agosaf.

Graef 2009

(6) $X \sim B(20, 0.6)$

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

Iteb tablau
$$P(X=10) = \binom{20}{10} 0.6^{10} (1-0.6)^{20-10}$$
$$= {}^{20}C_{10} \times 0.6^{10} \times 0.4^{10}$$
$$= 0.1171 \text{ i 4 lle degol}$$

Itefo tablau
 $Y = \text{nifer o flodau lliwgarll}$
 $Y \sim B(20, 0.4)$
$$P(X=10) = P(Y=10)$$
$$= P(Y \leq 10) - P(Y \leq 9)$$
$$= 0.8725 - 0.7553$$
$$= 0.1172$$

(ii) $P(X \geq 12) = 1 - P(X \leq 11)$

Iteb tablau: angen cyfrifo $1 - P(X=0) - P(X=1) - \dots - P(X=11)$

Itefo tablau: $P(X \geq 12) = P(Y \leq 8)$
$$= 0.5956$$

(b) $X \sim B(80, 0.04)$

n yn uchel, p yn isel felly $X \approx Po(np)$
 $X \approx Po(80 \times 0.04)$
 $X \approx Po(3.2)$

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

Itefo tablau:

$P(X \leq 4) = 0.7806$

Iteb tablau:

$$P(X \leq 4) = P(X=0) + P(X=1) + P(X=2) + P(X=3) + P(X=4)$$
$$= e^{-3.2} \frac{3.2^0}{0!} + e^{-3.2} \frac{3.2^1}{1!} + \dots + e^{-3.2} \frac{3.2^4}{4!}$$
$$= e^{-3.2} \left(\frac{3.2^0}{0!} + \frac{3.2^1}{1!} + \frac{3.2^2}{2!} + \frac{3.2^3}{3!} + \frac{3.2^4}{4!} \right)$$
$$= 0.780612511 \dots$$
$$= 0.7806 \text{ i 4 lle degol}$$

Haf 2009

③ $X \sim B(25, 0.8)$

(a) $E(X) = np$
 $= 25 \times 0.8$
 $= 20$

$Var(X) = npq$
 $= 25 \times 0.8 \times 0.2$
 $= 4$

(b) (i) $Y = aX - b$
 $Y = 2X - 3$

$E(Y) = 2E(X) - 3$
 $E(Y) = 2 \times 20 - 3$
 $E(Y) = 37$

$Var(Y) = 2^2 \times Var(X)$
 $Var(Y) = 4 \times 4$
 $Var(Y) = 16$

(ii) $Y = aX - b$

$E(Y) = 0$
 $0 = aE(X) - b$
 $0 = 20a - b$

$Var(Y) = 1$
 $1 = a^2 Var(X)$
 $1 = a^2 (4)$
 $a^2 = \frac{1}{4}$
 $a = \pm \sqrt{\frac{1}{4}}$
 $a = \pm \frac{1}{2}$

and mae a, b yn positif

felly $a = \frac{1}{2}$

↓
 $0 = 20(\frac{1}{2}) - b$
 $b = 10$

Gaeaf 2010

③ (a) $X \sim B(n, p)$

$$E(X) = np$$

$$10 = np \quad \text{--- ①}$$

$$\text{Var}(X) = npq$$

$$3^2 = npq$$

$$9 = npq \quad \text{--- ②}$$

Yn amnewid am np o ① i ②:

$$9 = (np)q$$

$$9 = 10q$$

$$q = \frac{9}{10}$$

$$q = 0.9.$$

felly $p = 0.1$

Yn amnewid yn ôl i ①:

$$10 = n(0.1)$$

$$\underline{n = 100}$$

(b) $Y \sim B(380, 0.016)$

n yn uchel, p yn isel felly

$$Y \approx Po(np)$$

$$Y \approx Po(380 \times 0.016)$$

$$Y \approx Po(6.08)$$

$$P(Y < 3) = P(Y \leq 2)$$

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

$$= e^{-6.08} \frac{6.08^0}{0!} + e^{-6.08} \frac{6.08^1}{1!} + e^{-6.08} \frac{6.08^2}{2!}$$

$$= e^{-6.08} \left(1 + 6.08 + \frac{6.08^2}{2} \right)$$

$$= 0.05849311741 \dots$$

$$= 0.0585 \text{ i 4 lle degol.}$$

⑤ $X \sim B(20, 0.8)$

(a) (i) $P(X=15)$

Heb tablau

$$\begin{aligned} P(X=15) &= \binom{20}{15} 0.8^{15} (1-0.8)^{20-15} \\ &= {}^{20}C_{15} \times 0.8^{15} \times 0.2^5 \\ &= 0.1746 \text{ i 4 lle degol} \end{aligned}$$

Hefo tablau

$Y = y$ nifer sydd ddim yn egino.

$$Y \sim B(20, 0.2).$$

$$\begin{aligned} P(X=15) &= P(Y=5) \\ &= P(Y \leq 5) - P(Y \leq 4) \\ &= 0.8042 - 0.6296 \\ &= 0.1746 \end{aligned}$$

(ii) $P(X \geq 15)$

Heb tablau: angen cyfrifo $P(X=15) + P(X=16) + \dots + P(X=20)$

$$\begin{aligned} \text{Hefo tablau: } P(X \geq 15) &= P(Y \leq 5) \\ &= 0.8042 \end{aligned}$$

Dull 1

(b) $P(X=n) = 0.10737$ efo $X \sim B(n, 0.8)$

$Y = y$ nifer sydd ddim yn egino.

$$Y \sim B(n, 0.2).$$

$$\begin{aligned} P(X=n) &= P(Y=0) \\ &= P(Y \leq 0). \end{aligned}$$

Yn edrych ar y tablau, $n=10$ sydd efo

$$P(Y \leq 0) = 0.1074. \text{ Felly } \underline{n=10}.$$

Dull 2

Y tebygolrwydd y byddant i gyd yn egino yw 0.8^n

Rydym angen $0.8^n = 0.10737$

$$\log(0.8^n) = \log(0.10737)$$

$$n \log(0.8) = \log(0.10737)$$

$$n = \frac{\log(0.10737)}{\log(0.8)}$$

$$\log(0.8)$$

$$n = 10.00017456$$

$$\underline{n=10} \text{ i'r rhif cyfan agasaf.}$$

Haf 2010

⑦ (a) $X \sim B(50, 0.2)$

(i) $P(X=12)$

Heb dablau

$$\begin{aligned} P(X=12) &= \binom{50}{12} 0.2^{12} (1-0.2)^{50-12} \\ &= {}^{50}C_{12} \times 0.2^{12} \times 0.8^{38} \\ &= 0.1033 \text{ i 4 lle degol} \end{aligned}$$

Hefo tablau

$$\begin{aligned} P(X=12) &= P(X \leq 12) - P(X \leq 11) \\ &= 0.8139 - 0.7107 \\ &= 0.1032 \end{aligned}$$

(ii) $P(X \geq 10) = 1 - P(X \leq 9)$

(Heb dablau: angen cyfrifo $1 - P(X=0) - P(X=1) - \dots - P(X=9)$)

$$\begin{aligned} \text{Hefo Tablau: } 1 - P(X \leq 9) \\ &= 1 - 0.4437 \\ &= 0.5563 \end{aligned}$$

(b) $X \sim B(200, 0.04)$

$$(0.2^2 = 0.04)$$

n yn uchel, p yn isel felly

$$X \approx \text{Po}(np)$$

$$X \approx \text{Po}(200 \times 0.04)$$

$$X \approx \text{Po}(8)$$

Heb dablau:

$$\begin{aligned} P(5 \leq X \leq 10) &= P(X=5) + P(X=6) + \dots + P(X=10) \\ &= e^{-8} \frac{8^5}{5!} + e^{-8} \frac{8^6}{6!} + \dots + e^{-8} \frac{8^{10}}{10!} \\ &= e^{-8} \left(\frac{8^5}{5!} + \frac{8^6}{6!} + \frac{8^7}{7!} + \frac{8^8}{8!} + \frac{8^9}{9!} + \frac{8^{10}}{10!} \right) \\ &= 0.7163 \text{ i 4 lle degol} \end{aligned}$$

Hefo Tablau:

$$\begin{aligned} P(5 \leq X \leq 10) &= P(X \leq 10) - P(X \leq 4) \\ &= 0.8159 - 0.0996 \\ &= 0.7163 \end{aligned}$$

Graef 2011

④ $X \sim B(n, 0.2)$

Cymedr = $2 \times$ gwyriad safonol

$$np = 2 \times \sqrt{npq}$$

$$n^2 p^2 = 4(npq) \quad [\text{sgwario}]$$

$$n^2 (0.2)^2 = 4(n \times 0.2 \times 0.8)$$

$$0.04n^2 = 0.64n$$

$$4n^2 = 64n \quad [\text{lluosio efo } 100]$$

$$n^2 = 16n$$

$$n^2 - 16n = 0$$

$$n(n-16) = 0$$

Unai $n=0$ neu $n-16=0$

$$n=16$$

Pe bai $n=0$ ni fyddai unrhyw dreialon felly rhaid bod $n=16$

⑧ (a) (i) $X \sim B(20, 0.05)$ Binomial

(ii) $P(X=1) = \binom{20}{1} 0.05^1 (1-0.05)^{20-1}$

$$= {}^{20}C_1 \times 0.05 \times 0.95^{19}$$

$$= 0.3773536025 \dots$$

$$= 0.3774 \text{ i } 4 \text{ lle degol}$$

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

$$= 1 - 0.9245$$

$$= 0.0755$$

(b) $X \sim B(20 \times 10 = 200, 0.05)$

n yn uchel, p yn isel felly

$$X \approx Po(np)$$

$$X \approx Po(200 \times 0.05)$$

$$X \approx Po(10)$$

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

$$= 0.0293$$

(o dablau)

Haf 2011

- ⑦ (a) (i) Mae'n rhaid i'r treialon fod yn annibynnol - ni ddylai canlyniad un treial ddylanwadu canlyniad arall.
(ii) Rhaid i'r tebygolrwydd o lwyddiant fod yr un fath ym mhob un o'r treialon.

(b) $X \sim B(20, 0.4)$

(i) $P(X=8)$

Heb dablau

$$\begin{aligned} P(X=8) &= \binom{20}{8} 0.4^8 (1-0.4)^{20-8} \\ &= {}^{20}C_8 \times 0.4^8 \times 0.6^{12} \\ &= 0.1797 \text{ i 4 lle degol} \end{aligned}$$

Heb dablau

$$\begin{aligned} P(X=8) &= P(X \leq 8) - P(X \leq 7) \\ &= 0.5956 - 0.4159 \\ &= 0.1797 \end{aligned}$$

(ii) $P(6 \leq X \leq 10)$

(Heb dablau: Angen cyfrifo $P(X=6) + P(X=7) + \dots + P(X=10)$.)

$$\begin{aligned} \text{Heb dablau: } P(6 \leq X \leq 10) &= P(X \leq 10) - P(X \leq 5) \\ &= 0.8725 - 0.1256 \\ &= 0.7469 \end{aligned}$$

(c) $X \sim B(100, 0.04)$

n yn uchel, p yn isel felly $X \approx \text{Po}(np)$
 $X \approx \text{Po}(100 \times 0.04)$
 $X \approx \text{Po}(4)$

$$\begin{aligned} P(X < 5) &= P(X \leq 4) \\ &= 0.6288 \text{ (o dablau).} \end{aligned}$$

$$\begin{aligned} \text{(Heb dablau: } P(X \leq 4) &= P(X=0) + P(X=1) + \dots + P(X=4) \\ &= e^{-4} \frac{4^0}{0!} + e^{-4} \frac{4^1}{1!} + e^{-4} \frac{4^2}{2!} + e^{-4} \frac{4^3}{3!} + e^{-4} \frac{4^4}{4!} \\ &= e^{-4} \left(1 + 4 + \frac{4^2}{2} + \frac{4^3}{3!} + \frac{4^4}{4!} \right) \\ &= 0.6288 \text{ i 4 lle degol.} \end{aligned}$$

Graef 2012

③ $X \sim B(10, 0.6)$

(a) (i) $P(X=7)$

Heb tablau

$$\begin{aligned} P(X=7) &= \binom{10}{7} 0.6^7 (1-0.6)^{10-7} \\ &= {}^{10}C_7 \times 0.6^7 \times 0.4^3 \\ &= 0.2150 \text{ i 4 lle degol} \end{aligned}$$

Heb tablau:

Y = nifer o weithiau mae

Bryn yn ennill.

$$Y \sim B(10, 0.4)$$

$$\begin{aligned} P(X=7) &= P(Y=3) \\ &= P(Y \leq 3) - P(Y \leq 2) \\ &= 0.3823 - 0.1673 \\ &= 0.2150 \end{aligned}$$

(ii) $P(X \geq 6)$

(Heb tablau: angen cyfrifo $P(X=6) + P(X=7) + \dots + P(X=10)$.)

Heb tablau: $P(X \geq 6) = P(Y \leq 4)$
 $= 0.6331$

(b) Bryn, Bryn, Bryn, Alun

$$0.4 \times 0.4 \times 0.4 \times 0.6$$

$$= 0.0384$$

⑧ $X \sim B(16, p)$

$(p < 0.5)$

$$\text{Var}(X) = 2.56$$

(a) $\text{Var}(X) = 2.56$

$$npq = 2.56$$

$$16p(1-p) = 2.56$$

$$16p - 16p^2 = 2.56$$

$$0 = 16p^2 - 16p + 2.56$$

$$0 = p^2 - p + 0.16$$

$$0 = (p - 0.2)(p - 0.8)$$

Unai $p - 0.2 = 0$ neu $p - 0.8 = 0$
 $p = 0.2$ $p = 0.8$

→ gan fod $p < 0.5$

rhaid bod $p = 0.2$

(b) $E(X) = np$

$$= 16 \times 0.2$$

$$= 3.2$$

$$\text{Var}(X) = E(X^2) - [E(X)]^2$$

$$2.56 = E(X^2) - 3.2^2$$

$$E(X^2) = 12.8$$

Haf 2012

④ $X \sim B(10, 0.75)$

(a) (i) $P(X=4)$

Heb tablau

$$\begin{aligned} P(X=4) &= \binom{10}{4} 0.75^4 (1-0.75)^{10-4} \\ &= {}^{10}C_4 \times 0.75^4 \times 0.25^6 \\ &= 0.0162 \text{ i' 4 lle degol} \end{aligned}$$

Heb tablau

$Y =$ nifer o weithiau mae

Dewi yn ennill.

$$Y \sim B(10, 0.25)$$

$$\begin{aligned} P(X=4) &= P(Y=6) \\ &= P(Y \leq 6) - P(Y \leq 5) \\ &= 0.9965 - 0.9803 \\ &= 0.0162 \end{aligned}$$

(ii) $P(X \geq 5)$

(Heb tablau: angen cyfrifo $P(X=6) + P(X=7) + \dots + P(X=10)$.)

$$\begin{aligned} \text{Heb tablau: } P(X \geq 5) &= P(X \geq 6) \\ &= P(Y \leq 4) \\ &= 0.9219 \end{aligned}$$

(b) $X \sim B(45, 0.08)$

n yn uchel, p yn isel felly

$$X \approx Po(np)$$

$$X \approx Po(45 \times 0.08)$$

$$X \approx Po(3.6)$$

$$\begin{aligned} P(X \geq 6) &= 1 - P(X \leq 5) \\ &= 1 - 0.9267 \\ &= 0.0733 \end{aligned}$$

Gaeaf 2013

② $X \sim B(16, 0.2)$
 $Y = 2X + 5$

(a) $E(X) = np$
 $= 16 \times 0.2$
 $= 3.2$

$Var(X) = npq$
 $= 16 \times 0.2 \times 0.8$
 $= 2.56$

$E(Y) = 2E(X) + 5$
 $= 2 \times 3.2 + 5$
 $= 11.4$

$Var(Y) = 2^2 \times Var(X)$
 $= 4 \times 2.56$
 $= 10.24$

(b) $P(Y=11) = P(2X+5=11)$
 $= P(2X=6)$
 $= P(X=3)$

Iteb tablau

$P(X=3) = \binom{16}{3} 0.2^3 (1-0.2)^{16-3}$
 $= {}^{16}C_3 \times 0.2^3 \times 0.8^{13}$
 $= 0.2463$ i 4 lle degol

Hefo tablau : Methu
(nid oes tablau kie
mae $n=16$).

⑤ (a) $X \sim B(20, 0.7)$

(i) $P(X=15)$

Iteb tablau

$P(X=15) = \binom{20}{15} 0.7^{15} (1-0.7)^{20-15}$
 $= {}^{20}C_{15} \times 0.7^{15} \times 0.3^5$
 $= 0.1789$ i 4 lle degol

Hefo tablau

$Y =$ nifer o flodau llw arall

$Y \sim B(20, 0.3)$

$P(X=15) = P(Y=5)$
 $= P(Y \leq 5) - P(Y \leq 4)$
 $= 0.4164 - 0.2375$
 $= 0.1789$

(ii) $P(X > 12)$

(Iteb dabbau: angen cyfrifo $P(X=13) + P(X=14) + \dots + P(X=20)$.)

Itefo tablau: $P(X > 12) = P(X \geq 13)$
 $= P(Y \leq 7)$
 $= 0.7723$

(b) $X \sim B(150, 0.09)$

n yn uchel, p yn isel felly $X \approx Po(np)$

$X \approx Po(150 \times 0.09)$

$X \approx Po(13.5)$

$P(X=10) = \frac{e^{-13.5} \times 13.5^{10}}{10!}$

$= 0.0760$ i 4 lle degol.

(Methu defnyddio tablau gan nodi oes colofn $m = 13.5$.)

Haf 2013

③ $X \sim B(25, 0.8)$

$Y = aX + b$

$E(Y) = 65$

$aE(X) + b = 65$

$a(np) + b = 65$

$a(25 \times 0.8) + b = 65$

$20a + b = 65$

$Var(Y) = 6^2$

$a^2 Var(X) = 36$

$a^2(npq) = 36$

$a^2(25 \times 0.8 \times 0.2) = 36$

$4a^2 = 36$

$a^2 = 9$

$a = \pm\sqrt{9}$

$a = \pm 3$

Onid mae $a, b > 0$ felly $a = 3$

$20(3) + b = 65$

$b = 65 - 60$

$b = 5$

④ (a) (i) $X \sim B(20, 0.25)$ Binomial

$$\begin{aligned} \text{(ii)} \quad P(3 \leq X \leq 9) &= P(X \leq 9) - P(X \leq 2) \\ &= 0.9861 - 0.0913 \\ &= 0.8948 \end{aligned}$$

$$\begin{aligned} \text{(iii)} \quad P(X=6) &= \binom{20}{6} 0.25^6 (1-0.25)^{20-6} \\ &= {}^{20}C_6 \times 0.25^6 \times 0.75^{14} \\ &= 0.1686 \text{ i 4 lle degol} \end{aligned}$$

(b) $X \sim B(160, 0.25^2 = 0.0625)$

n yn uchel, p yn isel felly $X \approx Po(np)$

$$X \approx Po(160 \times 0.0625)$$

$$X \approx Po(10)$$

(i) $P(X=12)$

Heb dablau

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

$$= 0.0948 \text{ i 4 l1.d.}$$

Hefo tablau

$$\begin{aligned} P(X=12) &= P(X \leq 12) - P(X \leq 11) \\ &= 0.7916 - 0.6968 \\ &= 0.0948 \end{aligned}$$

(ii) $P(6 \leq X \leq 14)$

(Heb dablau: angen cyfrifo $P(X=6) + P(X=7) + \dots + P(X=14)$.)

Hefo tablau: $P(6 \leq X \leq 14) = P(X \leq 14) - P(X \leq 5)$

$$\begin{aligned} &= 0.9165 - 0.0671 \\ &= 0.8494 \end{aligned}$$

SI Graef 2014

④ $X \sim B(20, 0.2)$

$$\begin{aligned} \text{(a) (i) } P(X=6) &= \binom{20}{6} 0.2^6 (1-0.2)^{20-6} \\ &= {}^{20}C_6 \times 0.2^6 \times 0.8^{14} \\ &= 0.1091 \text{ i 4 lle degol} \end{aligned}$$

$$\begin{aligned} \text{(ii) } P(2 \leq X \leq 8) &= P(X \leq 8) - P(X \leq 1) \\ &= 0.9900 - 0.0692 \\ &= 0.9208 \end{aligned}$$

(Hefo tablau)

b) $Y \sim B(200, 0.0123)$

n yn uchel a p yn isel felly $Y \approx Po(np)$
 $Y \approx Po(2.46)$

$$\begin{aligned} P(Y=3) &= e^{-2.46} \times \frac{2.46^3}{3!} \\ &= 0.2120 \text{ i 4 lle degol} \end{aligned}$$

Sl Graef 2014

⑥ $X \sim B(10, 0.75)$

(a) (i) $E(X) = np$
 $= 10 \times 0.75$
 $= 7.5$

$Var(X) = npq$
 $= 10 \times 0.75 \times 0.25$
 $= 1.875$

(ii)

x	$P(X=x)$
0	${}^{10}C_0 \times 0.75^0 \times 0.25^{10} = 0.00000095367$
1	${}^{10}C_1 \times 0.75^1 \times 0.25^9 = 0.00002861022$
2	${}^{10}C_2 \times 0.75^2 \times 0.25^8 = 0.00038623809$
3	${}^{10}C_3 \times 0.75^3 \times 0.25^7 = 0.00308990478$
4	${}^{10}C_4 \times 0.75^4 \times 0.25^6 = 0.01622200012$
5	${}^{10}C_5 \times 0.75^5 \times 0.25^5 = 0.05839920044$
6	${}^{10}C_6 \times 0.75^6 \times 0.25^4 = 0.1459980011$
7	${}^{10}C_7 \times 0.75^7 \times 0.25^3 = 0.2502822876$
8	${}^{10}C_8 \times 0.75^8 \times 0.25^2 = 0.2815675735$
9	${}^{10}C_9 \times 0.75^9 \times 0.25^1 = 0.1877117157$
10	${}^{10}C_{10} \times 0.75^{10} \times 0.25^0 = 0.05631351471$

o'r tabl, gwelwch mae gwerth mwyaf tebygol X yw $\underline{X=8}$.

(b) (i) $W = 10X - 2(10-X)$

$$W = 10X - 20 + 2X$$

$$W = 12X - 20$$

(Felly $a=12$, $b=20$)

(ii) $E(W) = E(12X - 20)$
 $= 12E(X) - 20$
 $= 12 \times 7.5 - 20$
 $= \pounds 70$

$Var(W) = Var(12X - 20)$
 $= 12^2 \times Var(X)$
 $= 144 \times 1.875$
 $= \pounds 270$

SI Haf 2014

② $X \sim B(n, p)$

Cymedr = 0.9

$np = 0.9$ — ①

Gwyriad safonol = 0.9

$\sqrt{npq} = 0.9$

$npq = 0.9^2$

$npq = 0.81$

Yn amnewid o ① am np

$(0.9)q = 0.81$

$q = 0.81 \div 0.9$

$q = 0.9$

Felly $p = 1 - q$

$p = 1 - 0.9$

$p = 0.1$

Amnewid yn $\hat{\sigma}^2$ i ①

$np = 0.9$

$n(0.1) = 0.9$

$n = 0.9 \div 0.1$

$n = 9$

SI Haf 2014

- ⑤ (a) $X \sim B(20, 0.55)$ cŵn benyw
 $Y \sim B(20, 0.45)$ cŵn gwryw

(i) $P(X=12)$

Heb dablau

$$\begin{aligned} P(X=12) &= \binom{20}{12} 0.55^{12} (1-0.55)^{20-12} \\ &= {}^{20}C_{12} 0.55^{12} 0.45^8 \\ &= 0.1623 \text{ i 4 lle degl.} \end{aligned}$$

Heb tablau: $P(X=12) = P(Y=8)$
 $= P(Y \leq 8) - P(Y \leq 7)$
 $= 0.4143 - 0.2520$
 $= 0.1623$

(ii) $P(8 \leq X \leq 16) = P(4 \leq Y \leq 12)$
 $= P(Y \leq 12) - P(Y \leq 3)$
 $= 0.9420 - 0.0049$
 $= 0.9371$

(b) $Z \sim B(60, 0.05)$

n yn uchel a p yn isel felly $Z \approx \text{Po}(np)$
 $Z \approx \text{Po}(3)$

$$\begin{aligned} P(Z < 5) &= P(Z \leq 4) \\ &= 0.8153 \quad (\text{o dablau}) \end{aligned}$$

SI Haf 2015

1) $X \sim B(10, 0.3)$

$$\begin{aligned} E(X) &= np \\ &= 10 \times 0.3 \\ &= 3 \end{aligned}$$

$$\begin{aligned} \text{Var}(X) &= npq \\ &= 10 \times 0.3 \times 0.7 \\ &= 2.1 \end{aligned}$$

(a) $Y = 2X + 1$

$$\begin{aligned} E(Y) &= 2E(X) + 1 \\ &= 2 \times 3 + 1 \\ &= 7 \end{aligned}$$

$$\begin{aligned} \text{Var}(Y) &= 2^2 \text{Var}(X) \\ &= 4 \times 2.1 \\ &= 8.4. \end{aligned}$$

Cymedr Y yw 7

Amrywiad Y yw 8.4

(b)
$$\begin{aligned} P(Y=7) &= P(2X+1=7) \\ &= P(2X=7-1) \\ &= P(2X=6) \\ &= P(X=3). \end{aligned}$$

Heb tablau:

$$\begin{aligned} P(X=3) &= \binom{10}{3} 0.3^3 (1-0.3)^{10-3} \\ &= {}^{10}C_3 0.3^3 0.7^7 \\ &= 0.266827932 \\ &= \underline{\underline{0.2668}} \text{ i 4 lle degol.} \end{aligned}$$

Hefo tablau:

$$\begin{aligned} P(X=3) &= P(X \leq 3) - P(X \leq 2) \\ &= 0.6496 - 0.3828 \\ &= \underline{\underline{0.2668}} \end{aligned}$$

SI Haf 2015

b) $X \sim B(50, 0.05)$

a) (i) Heb tablau:

$$\begin{aligned} P(X=2) &= \binom{50}{2} 0.05^2 (1-0.05)^{50-2} \\ &= {}^{50}C_2 0.05^2 0.95^{48} \\ &= \underline{\underline{0.2611}} \text{ i 4 lle degol} \end{aligned}$$

Hefo tablau:

$$\begin{aligned} P(X=2) &= P(X \leq 2) - P(X \leq 1) \\ &= 0.5405 - 0.2794 \\ &= \underline{\underline{0.2611}} \end{aligned}$$

(ii) Heb tablau: (anodd!)

$$\begin{aligned} P(3 \leq X \leq 8) &= P(X=3) + P(X=4) + \dots + P(X=8) \\ &= {}^{50}C_3 0.05^3 0.95^{47} + {}^{50}C_4 0.05^4 0.95^{46} \\ &\quad + {}^{50}C_5 0.05^5 0.95^{45} + {}^{50}C_6 0.05^6 0.95^{44} \\ &\quad + {}^{50}C_7 0.05^7 0.95^{43} + {}^{50}C_8 0.05^8 0.95^{42} \\ &= \underline{\underline{0.4587}} \text{ i 4 lle degol} \end{aligned}$$

Hefo tablau: (haws!)

$$\begin{aligned} P(3 \leq X \leq 8) &= P(X \leq 8) - P(X \leq 2) \\ &= 0.9992 - 0.5405 \\ &= \underline{\underline{0.4587}} \end{aligned}$$

b) $Y \sim B(250, 0.015)$

n yn uchel a p yn isel felly $Y \approx Po(np)$
 $Y \approx Po(3.75)$

$$\begin{aligned} P(Y=4) &= e^{-3.75} \frac{3.75^4}{4!} \\ &= \underline{\underline{0.1938}} \text{ i 4 lle degol} \end{aligned}$$

SI Haf 2016

$$⑥ \quad X \sim B(8, 0.12)$$

$$a) \quad (i) \quad P(X < 2) = P(X \leq 1)$$

Heb tablau:

$$\begin{aligned} P(X \leq 1) &= P(X=0) + P(X=1) \\ &= \binom{8}{0} 0.12^0 (1-0.12)^{8-0} + \binom{8}{1} 0.12^1 (1-0.12)^{8-1} \\ &= 0.7519630973 \\ &= 0.7520 \quad \text{i 4 lle degol.} \end{aligned}$$

[Heb tablau:
 $P(X \leq 1) =$ Ddim yn bosib; $p=0.12$ ddim yn y tablau.]

$$\begin{aligned} (ii) \quad P(X=2) &= \binom{8}{2} 0.12^2 (1-0.12)^{8-2} \\ &= 0.1872477278 \\ &= 0.1872 \quad \text{i 4 lle degol} \end{aligned}$$

$$\begin{aligned} (iii) \quad P(X > 2) &= 1 - P(X \leq 2) \\ &= 1 - P(X=2) - P(X \leq 1) \\ &= 1 - 0.1872477278 - 0.7519630973 \\ &= 0.06078917491 \\ &= 0.0608 \quad \text{i 4 lle degol.} \end{aligned}$$

$$\begin{aligned} b) \quad \text{Elw disgwyliedig} &= (-£5) \times P(X < 2) \\ &\quad + (£10 - £5) \times P(X = 2) \\ &\quad + (£25 - £5) \times P(X > 2) \\ &= -5 \times 0.7520 + 5 \times 0.1872 + 20 \times 0.0608 \\ &= -1.608 \\ &= -£1.61 \quad \text{i 2 lle degol.} \end{aligned}$$

(Felly mae £1 yn gumed colled disgwyliedig.)

Si Haf 2016

(8) $X \sim Po(3)$

a) Mae $B(n, p)$ yn frasamcan ar gyfer $Po(np)$

Gyda $n = 50$, $np = 3$ rhaid bod $50p = 3$
 $p = \frac{3}{50}$
 $p = 0.06$

b) $P(X=2)$ gan ddefnyddio $X \approx B(50, 0.06)$

$$\begin{aligned}
 P(X=2) &= \binom{50}{2} 0.06^2 (1-0.06)^{50-2} \\
 &= \frac{50!}{(50-2)! \times 2!} \times 0.06^2 \times 0.94^{48} \\
 &= \frac{50 \times 49 \times (48 \times \dots \times 2 \times 1)}{(48 \times 47 \times \dots \times 2 \times 1) \times (2 \times 1)} \times 0.06^2 \times 0.94^{48} \\
 &= \frac{2450}{2} \times 0.06^2 \times 0.94^{48} \\
 &= 1225 \times 0.06 \times 0.06 \times \underbrace{0.94 \times 0.94 \times \dots \times 0.94}_{48 \text{ o weithiau}} \\
 &= 0.2262432143 \\
 &= 0.2262 \text{ i 4 lle degol}
 \end{aligned}$$

c) $P(X=2)$ gan ddefnyddio $X \sim Po(3)$

$$\begin{aligned}
 P(X=2) &= P(X \leq 2) - P(X \leq 1) \\
 &= 0.4232 - 0.1991 \\
 &= 0.2241
 \end{aligned}$$

Fel canran o'r 0.2241, mae'r brasamcan yn
 $(0.2262 \div 0.2241) \times 100\% = 100.9370817\%$
 felly o fewn 1% i'r gwerth o'r tabl ✓
 (Mae 100.937...% yn llai na 101%)

SI Haf 2017

(Gadewch i X ddynodi nifer y gemau wedi'u hennill gan Anne y diwrnod hwnnw.)

5) $X \sim B(10, 0.7)$

Mae X yn dilyn dosraniad Binomial efo $n = 10$, $p = 0.7$.

$$\begin{aligned} \text{(ii)} \quad E(X) &= np \\ &= 10 \times 0.7 \\ &= 7 \end{aligned}$$

$$\begin{aligned} \text{Var}(X) &= npq \\ &= 10 \times 0.7 \times 0.3 \\ &= 2.1 \end{aligned}$$

Gwryriad safonol X yw $\sqrt{2.1}$
 $= 1.4491$ i 4 ll.d.

(iii) Rydym angen $P(X \geq 6)$.

$$\begin{aligned} &\text{Heb dablau: } P(X \geq 6) \\ &= P(X=6) + P(X=7) + P(X=8) + P(X=9) + P(X=10) \\ &= \binom{10}{6} 0.7^6 (1-0.7)^{10-6} + \binom{10}{7} 0.7^7 (1-0.7)^{10-7} \\ &\quad + \binom{10}{8} 0.7^8 (1-0.7)^{10-8} + \binom{10}{9} 0.7^9 (1-0.7)^{10-9} \\ &\quad + \binom{10}{10} 0.7^{10} (1-0.7)^{10-10} \\ &= \binom{10}{6} 0.7^6 0.3^4 + \binom{10}{7} 0.7^7 0.3^3 + \binom{10}{8} 0.7^8 0.3^2 \\ &\quad + \binom{10}{9} 0.7^9 0.3^1 + \binom{10}{10} 0.7^{10} 0.3^0 \\ &= 0.8497316674 \\ &= 0.8497 \text{ i 4 lle degol} \end{aligned}$$

Hefo tablau:

X gemau mae Anne yn ennill

$$X \sim B(10, 0.7)$$

Y gemau mae Brian yn ennill

$$Y \sim B(10, 0.3)$$

$$P(X \geq 6) = P(Y \leq 4)$$

$$= 0.8497$$

(o dablau)

- b) Gadewch i Z ddynodi y nifer o gemau sy'n cymryd mwy nag 1 awr i w cublhan.

$$Z \sim B(44, 0.06)$$

Mae n yn uchel a p yn isel felly $Z \approx Po(np)$

$$Z \approx Po(2.64)$$

$$P(Z > 2) = 1 - P(Z \leq 2)$$

$$= 1 - P(Z=2) - P(Z=1) - P(Z=0)$$

$$= 1 - e^{-2.64} \times \frac{2.64^2}{2!} - e^{-2.64} \times \frac{2.64^1}{1!}$$

$$- e^{-2.64} \times \frac{2.64^0}{0!}$$

$$= 1 - e^{-2.64} \left(\frac{2.64^2}{2} + 2.64 + 1 \right)$$

$$= 1 - e^{-2.64} (7.1248)$$

$$= 0.4915652267$$

$$= \underline{\underline{0.4916}} \text{ i 4 lle degol}$$

SI Haf 2018

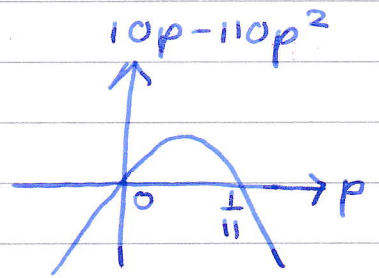
4) $X \sim B(10, p)$

$$E(X) = np \\ = 10p$$

$$\text{Var}(X) = npq \\ = 10p(1-p)$$

Gwyriad safonol X yn fwy na chymedr X

$$\begin{aligned} \sqrt{10p(1-p)} &> 10p \\ 10p(1-p) &> 100p^2 \\ 10p - 10p^2 &> 100p^2 \\ 10p - 110p^2 &> 0 \\ 10p(1-11p) &> 0 \end{aligned}$$



Gwerthoedd critigol: $10p = 0$ neu $1 - 11p = 0$
 $p = 0$ $1 = 11p$
 $p = \frac{1}{11}$

Ateb: $0 < p < \frac{1}{11}$

51 Haf 2018

- 8) ca) Dosraniad X yw'r dosraniad Binomial.
 $X \sim B(20, 0.6)$

$$\begin{aligned} \text{ii) } P(X=15) &= \binom{20}{15} 0.6^{15} (1-0.6)^{20-15} \\ &= {}^{20}C_{15} 0.6^{15} 0.4^5 \\ &= \underline{\underline{0.0746}} \text{ i 4 lle degol} \end{aligned}$$

iii) Hefo tablau:

X nifer syn eginio
 $X \sim B(20, 0.6)$

Y nifer nad ywin eginio
 $Y \sim B(20, 0.4)$

$$\begin{aligned} P(X \geq 15) &= P(Y \leq 5) \\ &= \underline{\underline{0.1256}} \end{aligned}$$

Iteb dablau:

$$\begin{aligned} P(X \geq 15) &= P(X=15) + P(X=16) + \dots + P(X=20) \\ &= {}^{20}C_{15} 0.6^{15} 0.4^5 + {}^{20}C_{16} 0.6^{16} 0.4^4 \\ &\quad + \dots + {}^{20}C_{20} 0.6^{20} 0.4^0 \\ &= 0.1255989727 \\ &= \underline{\underline{0.1256}} \text{ i 4 lle degol} \end{aligned}$$

- b) $Y \sim B(200, 0.05)$

n yn uchel a p yn isel felly $Y \approx Po(np)$
 $Y \approx Po(10)$

$$\begin{aligned} \text{i) } P(Y=8) &= e^{-10} \frac{10^8}{8!} \\ &= \underline{\underline{0.1126}} \text{ i 4 lle degol} \end{aligned}$$

$$\text{ii) } P(X > 12) = 1 - P(X \leq 12)$$

$$= 1 - 0.7916$$

$$= \underline{\underline{0.2084}}$$

(ör tablan)