1) a) \[ \text{Ans: } C = 4, \quad m = 3 \]

Take log of both \[ y = C x^m \]
to obtain \[ \log y = \log C + m \log x \]

if \( x = 1 \), \( y = C = 4 \)

They, for example at \( x = 3 \), \( y \approx 108 \) (inspection of answer)

\[ 108 = 4 \times 3^m \text{ or } m = 3 \]

b) See graph on following page

2) Taylor 10.08

\[ B_{n, \frac{1}{2}}(u) = \frac{n!}{u!(n-u)!} \cdot p^u (1-p)^{n-u} \]

\( n = 4, \quad p = \frac{1}{2}, \quad u = 0, 1, 2, 3, 4 \)

\[ B_{4, \frac{1}{2}}(0) = 0.9096 \]
\[ B_{4, \frac{1}{2}}(1) = 0.4096 \]
\[ B_{4, \frac{1}{2}}(2) = 0.1536 \]
\[ B_{4, \frac{1}{2}}(3) = 0.0256 \]
\[ B_{4, \frac{1}{2}}(4) = 0.0016 \]
Figure 1: Log-Log graph for Problem 1 (a).

Figure 2: Log-Log graph for Problem 1 (b).
2) Taylor 10.10

Use Binomial Distn: $B_n, \rho (r) = \frac{m!}{r!(m-r)!} \rho^r (1-\rho)^{m-r}$

$\rho = \text{probability of survival} = 0.20$

$m = 4$

a) None survives: $r = 0$  $B_4, 0.2 (0) = \frac{4!}{0!(4-0)!} 0.2^0 (1-0.2)^{4-0}$

$= 0.4096$

b) One survives: $r = 1$  $B_4, 0.2 (1) = \frac{4!}{1!(4-1)!} 0.2^1 (1-0.2)^{4-1}$

$= 0.4096$

c) 2, 3, or 4 survive

This is just what's left after $r = 0, 1$ possibilities

$1 - (0.4096 + 0.4096) = 0.1808$
5) \( \text{Taylor 11.08} \)

a) \( M_{\text{best}} = \frac{1}{N} \sum_{i=1}^{N} X_i = \frac{1}{15} (7 + 11 + 10 + 7 + 5 + 7 + 6 + 12 + 12 + 7 + 6 + 12 + 13 + 12 + 6) = 9.67 \)

b) Std Dev = \( \frac{1}{N} \sum_{i=1}^{N} \left( X_i - \overline{X} \right)^2 = 3.48 \)

(Alternatively \( \frac{1}{N-1} \sum_{i=1}^{N} (X_i - \overline{X})^2 = 3.60 \))

\( \sqrt{\text{mean}} = \sqrt{9.67} = 3.11 \) close!

6) \( \text{Taylor 11.16} \)

25 counts recorded in 15 seconds

a) \( M_{\text{best}} = \frac{25}{\sqrt{25}} = 25 \pm 5 \) counts in 15 secs

b) RATE IN PARTICLES PER MINUTE?

Relative error (20%) remains the same. Moreover, count/15 sec = \( \frac{25}{15} \) sec by 4:

\( \text{rate} = 100 \pm 20 \) counts/minute

6) \( \text{Taylor 5.06} \)

a) \( f(t) \)

\[ \begin{align*}
  \int_{-\infty}^{\infty} f(t)dt &= \int_{0}^{\infty} \frac{1}{2\pi} e^{-t/\lambda}dt = -e^{-t/\lambda} \bigg|_{0}^{\infty} = 1 \\
  \text{Satisfies Normalization Condition}
\end{align*} \]

b) \( \overline{t} = \int_{0}^{\infty} t \cdot \frac{1}{2\pi} e^{-t/\lambda}dt \)

Let \( \lambda = \frac{1}{\sqrt{2}} \)

\[ \begin{align*}
  \overline{t} &= \lambda \cdot \frac{\lambda}{2\pi} \int_{0}^{\infty} e^{-\lambda t}dt = \lambda \cdot \frac{\lambda}{2\pi} \left[ -\frac{1}{\lambda} e^{-\lambda t} \right]_{0}^{\infty} = \lambda \cdot \frac{\lambda}{2\pi} \left( 0 - 1 \right) = \lambda \frac{\lambda}{2\pi} \left( 1 \right) = \frac{1}{\lambda} \overline{t} = \frac{1}{\lambda} = 2
\end{align*} \]
Taylor Problem 11.02

P_i(0) = 0.367879
P_i(1) = 0.367879
P_i(2) = 0.18394
P_i(3) = 0.0613132
P_i(4) = 0.0153283
P_i(5) = 0.00306566
P_i(6) = 0.000510944

Poisson Mean = 1

P_i(0) = 0.135335
P_i(1) = 0.270671
P_i(2) = 0.270671
P_i(3) = 0.180447
P_i(4) = 0.0902235
P_i(5) = 0.0360894
P_i(6) = 0.0120298

Poisson Mean = 2
7) \[ f(x) = A e^{-\frac{x^2}{2d^2}}, \text{ w/ maximum value } A \]

Let \( \delta = \text{FWHM} \)

\[ f(\frac{\delta}{2}) = \frac{A}{2} = A e^{-\left(\frac{\delta}{2}\right)^2/2d^2} \]

\[ \ln(\frac{1}{2}) = \frac{-\left(\frac{\delta}{2}\right)^2}{2d^2} \]

\[ 2d^2 \ln(2) = \left(\frac{\delta}{2}\right)^2; \quad \delta = \text{FWHM} = 2d \sqrt{2 \ln 2} = 2.35d \]

8) \[ \text{Reading Table A p6 287...} \]

\[ x \pm 2d \rightarrow 95.45\% \text{ w/ this interval} \]

\[ x \pm 1.96d \rightarrow 95.00\% \text{ w/ this interval} \]