TAYLOR 4.6

(a) $\bar{x} = \sum x_i / N$ w/ $N=20$

$\bar{x} = 10.7$

$$\sigma_x = \left[\frac{\sum (x_i - \bar{x})^2}{N-1} \right]^{1/2} = 3.40$$

(b) $\sigma_x \simeq \sqrt{\bar{x}} = 3.27 \simeq 3.40$

TAYLOR 4.7

(a)

$\bar{x} = \Sigma x_i / N$ w/ $N=5$

$\bar{x} = \cancel{3.4}\ 15.4$; $\sigma = \left(\frac{(x_i - \bar{x})^2}{N-1} \right)^{1/2}$

$\cancel{\Sigma x_i = 77}$

$= 3.5$

$\sigma \simeq \sqrt{\bar{x}} = \sqrt{15.4} = 3.9$, CLOSE TO 3.5

(b) $y = \sqrt{\nu}$ SEEK ERROR IN y

$\sigma_y^2 = \left(\frac{\partial f}{\partial \nu}\right)^2 \sigma_\nu^2$

$= \left(\frac{1}{2}\right)^2 \frac{1}{\nu} \sigma_\nu^2$

$\sigma_y = \frac{1}{2} \sigma_\nu / \sqrt{\nu}$, BUT $\sigma_\nu = \sqrt{\nu}$

SO, $\boxed{\sigma_y = \frac{1}{2} = 0.5}$

ANSWERS FOR THE TWO WAYS OF COMPUTING σ AGREE.

TEC 1

a) $\overline{BKG}/min = \dfrac{58 \pm \sqrt{58}}{5\ min}$

$$\boxed{\overline{BKG} = 11.6 \pm 1.5\ min^{-1}}$$

CORRECT COUNTS = $\overline{RAW} - \overline{BKG}$

$\sigma^2(CC) = \sigma^2(\overline{RAW}) + \sigma^2(\overline{BKG})$

$\overline{RAW} = 1232/10\ min \pm \sqrt{1232}/10\ min$

$= 123.2 \pm 3.5\ min^{-1}$

CORRECT COUNTS $= 123.2 - 11.6\ min^{-1} = 111.6/min$

w/ ERROR $= [1.5^2 + 3.5^2]^{1/2}/min = 3.8/min$

$$\boxed{CC = 111.6 \pm 3.8\ min^{-1}}$$

NOTE! NO ERROR IN LENGTH OF TIME PERIOD DURING WHICH DATA IS COLLECTED.

FOR PROBABILITY DISTRIBUTION $f(x)$
w/ $\int_{-\infty}^{\infty} dx\, f(x) = 1$ AND MEAN μ

WE HAVE

$$\sigma^2 \equiv \int_{-\infty}^{\infty} dx\, f(x)\,(x-\mu)^2$$

$$= \int_{-\infty}^{\infty} dx\, f(x)\, x^2 \; - 2\mu \int_{-\infty}^{\infty} dx\, f(x)\, x \; + \mu^2 \int_{-\infty}^{\infty} dx\, f(x)$$

$$= \overline{x^2} - 2\mu^2 + \mu^2$$

$$\boxed{\sigma^2 = \overline{x^2} - \mu^2}$$

TRUE FOR ANY RANDOM PROBABILITY DISTRIBUTION
(e.g., BINOMIAL, GAUSSIAN, POISSON, ...)