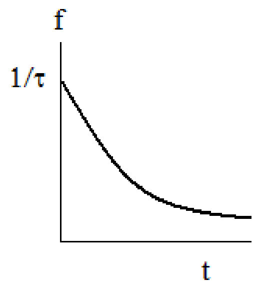
**Homework 3 Solutions**

Ch. 5   6,12,20,22,34,36

**5.6**

(a)




(b) $\int_0^\infty \frac{1}{\tau} e^{-t/\tau} dt = \int_0^\infty e^{-z} dz = 1$

(c) $\bar{t} = \int_0^\infty t f(t) dt = \int_0^\infty \frac{t}{\tau} e^{-t/\tau} dt = \tau \int_0^\infty z e^{-z} dz = \tau$

For parts (b) and (c), we used the substitution $z = t/\tau$ and the identity $n! = \int_0^\infty z^n e^{-z} dz$

**5.12**

Since we are looking at the width (not the position) of the distribution, we can consider a Gaussian centered about the origin. Then, the Gaussian has ½ its maximum value when

$$\exp\left(-\frac{x^2}{2\sigma^2}\right) = \frac{1}{2} \qquad \frac{x^2}{2\sigma^2} = \ln 2 \qquad x = \sigma\sqrt{2\ln 2}$$

Therefore, $FWHM = 2x = 2\sigma\sqrt{2\ln 2}$

**5.20**

(a) This is a range between -1 and +1 σ. Therefore, 68.3% of the population would fall in this range, or 683 men.
(b) This is over +1 σ. Therefore, 0.5 - 0.3413 = 15.9% fall in this range, or 159 men.
(c) This is over +3 σ. 0.5 - 49.87 = 0.13% fall in this range, or about 1 man.
(d) This is between -2 and -1 σ. 15.9% are below -1 σ, while 2.3% are below -2 σ, so 13.6% fall in this intermediate range, or about 136 men.

**5.22**

First, move the Gaussian to the origin by setting X to zero. This corresponds to the substitution $x \to x + X$. Then,

$$P(t\sigma) = \frac{1}{\sigma\sqrt{2\pi}} \int_{-t\sigma}^{+t\sigma} \exp\left(-\frac{x^2}{2\sigma^2}\right) dx$$

Now, let $x = \sigma z$. Then, $dx = \sigma dz$, and *z* runs between -*t* and +*t*.

$$P(t) = \frac{1}{\sqrt{2\pi}} \int_{-t}^{+t} \exp\left(-\frac{z^2}{2}\right) dz = erf(t)$$

**5.34**

Utilizing the table of the erf function in Appendix A of the book, we find that 5% significance requires $t > 1.96$, 2% significance requires $t > 2.32$, and 1% significance requires $t > 2.58$.

**5.36**

(a) The discrepancy is $(15-13) \pm \sqrt{1^2 + 1^2} = 2.0 \pm 1.4$

(b) In this case, $t = 2/1.4 \approx 1.4$, which means that there is a 16% chance of getting results with this discrepancy by random chance alone. Thus, this discrepancy is not significant at the 5% level; 5% confidence would require the probability of a false positive due to random chance to be below 5%, and thus require a *t* value of at least 1.96.