# Chemistry 236 -- Quiz 2

Lab Day ____

September 30, 2009 — Probability Distributions and Related Statistics

**Pledge and signature:**

**Note:** If you want your paper returned folded (*i.e.*, score concealed), please print your name on the back.

1. (8) Consider the probability distribution, $P(x) = cx^2$, defined over the range $0 \le x \le 2$. For this distribution, calculate: (a) the normalization constant, (b) the mean, (c) the standard deviation, and (d) the median.

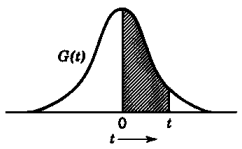
(a) $c = 3/8$ (b) mean = 3/2 (c) var = 3/20 $\sigma = (3/20)^{1/2}$

(d) median = $4^{1/3}$

2. (4) If you generate $10^5$ random numbers using this distribution, how many would you expect to fall within the range 1.40–1.50? What is the standard deviation of this value?

number = 7888 sd = 89 (Poisson approx)

Table 4-4. Error Function $\frac{1}{2}$ erf $(t)$ from 0 to $t$ and Ordinate Values $G(t) = (1/\sqrt{2\pi})\, e^{-t^2/2}$




| $t$ | $\frac{1}{2}$ erf $(t)$ Area | $G(t)$ Ordinate | $t$ | $\frac{1}{2}$ erf $(t)$ Area | $G(t)$ Ordinate |
|---|---|---|---|---|---|
| 0 | 0 | 0.3989 | 2.0 | 0.4773 | 0.0540 |
| 0.1 | 0.0398 | 0.3970 | 2.1 | 0.4821 | 0.0440 |
| 0.2 | 0.0793 | 0.3910 | 2.2 | 0.4861 | 0.0355 |
| 0.3 | 0.1179 | 0.3814 | 2.3 | 0.4893 | 0.0283 |
| 0.4 | 0.1554 | 0.3683 | 2.4 | 0.4918 | 0.0224 |
| 0.5 | 0.1915 | 0.3521 | 2.5 | 0.4938 | 0.0175 |
| 0.6 | 0.2258 | 0.3332 | 2.6 | 0.4953 | 0.0136 |
| 0.7 | 0.2580 | 0.3123 | 2.7 | 0.4965 | 0.0104 |
| 0.8 | 0.2881 | 0.2897 | 2.8 | 0.4974 | 0.0079 |
| 0.9 | 0.3159 | 0.2661 | 2.9 | 0.4981 | 0.0060 |
| 1.0 | 0.3413 | 0.2420 | 3.0 | 0.4987 | 0.0044 |
| 1.1 | 0.3643 | 0.2179 | 3.1 | 0.4990 | 0.0033 |
| 1.2 | 0.3849 | 0.1942 | 3.2 | 0.4993 | 0.0024 |
| 1.3 | 0.4032 | 0.1714 | 3.3 | 0.4995 | 0.0017 |
| 1.4 | 0.4192 | 0.1497 | 3.4 | 0.4997 | 0.0012 |
| 1.5 | 0.4332 | 0.1295 | 3.5 | 0.4998 | 0.0009 |
| 1.6 | 0.4452 | 0.1109 | 3.6 | 0.4998 | 0.0006 |
| 1.7 | 0.4554 | 0.0941 | 3.8 | 0.4999 | 0.0003 |
| 1.8 | 0.4641 | 0.0790 | 4.0 | 0.5000 | 0.0001 |
| 1.9 | 0.4713 | 0.0656 | 4.4 | 0.5000 | 0.0000 |

3. (4) You now generate $10^5$ *averages* of 21 such random numbers.

   a. Calculate the expected mean and standard deviation for these averages.

   mean = 3/2 (same) $\sigma_{mean} = \sigma/21^{1/2} = 0.084515$

   b. Use the table on the first page to estimate how many of the $10^5$ averages would fall between 1.40 and 1.50.

   38,140

4. (4) You used the ran() command in KaleidaGraph to generate random numbers in the range 0–1. Write **exactly** what you entered in the KG Formula Entry box to obtain

   a. an average of two random numbers in column c1.

   c1 = (ran() + ran())/2

   b. the three-step sequence of commands you used to obtain an average of 12 random numbers in c2.

   (1) c2 = ran() + ran() + ran()

   (2) c2 = c2 + ran() + ran() + ran() [execute 3 times]

   (3) c2 = c2/12

5. (3) In one of your KG3 exercises, you fitted data to a declining exponential function plus a background, requiring three adjustable parameters. Using a, b, and c for these, write **exactly** what you had to enter in the Define Fit box to carry out this nonlinear LS fit.

   a*exp(-b*x) + c; (and give initial values)

6. (5) A quantity $x$ is uncertain by 3.0% and $y$ is uncertain by 4.0%. Give the % uncertainties for $z$ in each of the following cases:

   a. $z = 9/y$

   4.0%

   b. $z = 3\,x^5$

   15.0%

   c. $z = 1/\sqrt{8y}$

   2.0%

   d. $z = 5\,x^2/y$

   $(52)^{1/2}$ %

   e. $z = 23\,y/x^2$

   $(52)^{1/2}$ %