Week 8: Reading Assignment, Homework Assignment

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Course Website: http://courses.physics.illinois.edu/phys598aem/

All lecture notes, homework, demos, references, *etc*. are available on the P598AEM website. Please spend some time checking these out!

Course Organization:

A. Lectures: Tuesday & Thursday, 12:30-1:50 pm, in 136 Loomis.
B. Weekly Reading and Homework Assignments: HW due following Thursday, in class.
C. Take-Home Midterm Exam: Oct. 10th, due Oct. 17th (in lieu of P598AEM HW 7).
D. Take-Home Final Exam: Dec. 10th, due Dec. 17th.

Reading Assignment For Week 8: Please read/work through P598AEM Lect. Notes 14-15.
Homework Assignment For Week 8: See/do HW # 8 problems on following pages.

Physics 598AEM Week 8 Homework Assignment

For the following HW problems, we encourage you to use whatever software works for you. See also P598AEM Lect. Notes 13, *p*. 15-18 and *e.g*. "Some Examples of χ^2 Distributions" {**Chi2_Distns.xls**} on the P598AEM Software webpage:
http://courses.physics.illinois.edu/phys598aem/598aem_sw.html

1.) Make linear ***and*** semilog plots of the χ^2 PDF $f\left(\chi^2;M\right)\equiv\frac{1}{2^{\frac{M}{2}}\Gamma\left(\frac{M}{2}\right)}\left(\chi^2\right)^{\frac{M}{2}-1}e^{-\chi^2/2}$ *vs.* χ^2

for M = 1, 2, 3, 4, 5, 7, 17 and 27 degrees of freedom.

Note that the gamma function is: $\Gamma\left(x\right)=\int_0^\infty e^{-t}t^{x-1}dt$. However, for ***integer*** M: $\Gamma\left(M\right)=\left(M-1\right)!$

Also note that: $\Gamma\left(x+1\right)=x\Gamma\left(x\right)$, and that: $\Gamma\left(\frac{1}{2}\right)=\sqrt{\pi}$.

2.) Make linear ***and*** semilog plots of the χ^2 PDF ***per degree of freedom***,

$\frac{f\left(\chi^2;M\right)}{M}\equiv\frac{1}{M}\cdot\frac{1}{2^{\frac{M}{2}}\Gamma\left(\frac{M}{2}\right)}\left(\chi^2\right)^{\frac{M}{2}-1}e^{-\chi^2/2}$ *vs.* χ^2 for M = 1, 2, 3, 4, 5, 7, 17 and 27 degrees of freedom.

3.) Make linear plots of the χ^2 CDF $F\left(\chi^2_{\max};M\right)\equiv\int_0^{\chi^2_{\max}}f\left(\chi^2;M\right)d\chi^2$ *vs.* $\chi^2_{\max}$

for M = 1, 2, 3, 4, 5, 7, 17 and 27 degrees of freedom.

4.) Make linear ***and*** log-log plots of the *p*-value (*aka* Single-Sided Upper Confidence Level, $C.L._{SS}^{Upper}$):

p-value $=C.L._{SS}^{Upper}\equiv100\left[1-F\left(\chi^2;M\right)\right]$ *vs.* χ^2 for M = 1, 2, 3, 4, 5, 7, 17 and 27 degrees of freedom.

5.) Explicitly compare/check your numerical results *e.g.* for a few ***specific*** points on the $p\text{-value} = C.L._{SS}^{Upper} \equiv 100\left[1 - F\left(\chi^2; M\right)\right]$ *vs.* χ^2 *vs.* M curves in HW problem 4.) above with tabulated "Critical Values of the χ^2 Distribution", posted on the P598AEM Software webpage: **http://courses.physics.illinois.edu/phys598aem/Software/Critical_Values_of_the_Chi-Squared_Distribution.pdf**

Do your curves agree with the tabulated upper single-sided critical values?