Logistics

- The exam will be given in SB 128. Because that room is not quite large enough for our class, the exam will be in two shifts: 8:00–9:00 and 9:00–10:00. Those in the first shift may come a bit early. Those in the second shift may stay a bit late.
- You will have access to the computers so that you can use R, sage, and Mathematica.
- Be sure to indicate how you use the computer on the exam. **No mystry numbers or expressions, please.**
- Use good notation and show all work. Full credit will not be given if your answers are not sufficiently supported.
- The format will be similar to the previous tests.

Material Covered

Test 3 covers chapters 1–3, 5 and 7 of the statistics text. It may also include a review question from line integrals (Sections 13.1–13.4) For more details about what we covered when, consult the web calendar.

A few more details

1. Three kinds of distributions: discrete, continuous, data
2. Numerical summaries: mean, variance, standard deviation, quantiles (including median).
   (a) Rules for means and variances of sums and linear transformations of random variables
3. Graphical summaries: stemplot, histogram, boxplot, quantile-quantile plot, scatter plot (including how to get R to make them)
4. For familiar distributions (see table), you should know how to use the relevant functions in R (`dnorm()`, `pnorm()`, `qnorm()`, etc.). We now have the t-distributions, too.
5. Probability
   (a) Empirical and Theoretical Probability
   (b) 3 Axioms
   (c) Other Useful Rules (Sum Rule, Complement Rule, etc.)
   (d) Conditional Probability and Independence
6. Sampling Distributions and the Central Limit Theorem
7. Confidence Intervals
   (a) CIs in the following situations: 1-sample t, 2-sample t, paired t, 1-proportion
   (b) prediction intervals, but NOT tolerance intervals
   (c) sample size calculations
   (d) 1-sided confidence intervals
   (e) You should be able to do these "from scratch" or using `t.test()` and `prop.test()`.
8. Linear Models (Regression) will NOT be covered on this test.

Distributions Cheat Sheet

The following table will be printed on your exam.

distribution	mass or density function	mean	variance
Poisson	$\texttt{dpois(x,}\lambda\texttt{)} = e^{-\lambda}\frac{\lambda^x}{x!}$	λ	λ
Binomial	$\texttt{dbinom(x,n,}\pi\texttt{)} = \binom{n}{x}\pi^x(1-\pi)^{n-x}$	$n\pi$	$n\pi(1-\pi)$
Geometric	$\texttt{dgeom(x,}\pi\texttt{)} = \pi(1-\pi)^x$	$\frac{1}{\pi}-1$	$\frac{1-\pi}{\pi^2}$
Neg. Binomial	$\texttt{dnbinom(x,size=}s\texttt{,prob=}\pi\texttt{)} = \binom{x+n-1}{s}\pi^n(1-\pi)^x$	$\frac{s}{\pi}-s$	$\frac{s(1-\pi)}{\pi^2}$
Uniform	$\texttt{dunif(x,a,b)} = \frac{1}{b-a}$ on $[a,b]$	$\frac{b+a}{2}$	$\frac{(b-a)^2}{12}$
Std. normal	$\texttt{dnorm(x,0,1)} = \frac{1}{\sqrt{2\pi}}e^{-\frac{1}{2}z^2}$	0	1
Normal	$\texttt{dnorm(x,}\mu\texttt{,}\sigma\texttt{)} = \frac{1}{\sigma\sqrt{2\pi}}\cdot e^{-\frac{1}{2}(\frac{x-\mu}{\sigma})^2}$	μ	σ^2
Lognormal	$\texttt{dlnorm(x,meanlog=}\mu\texttt{,sdlog=}\sigma\texttt{)} = \frac{1}{\sigma\sqrt{2\pi}}\cdot e^{-[\ln(x)-\mu]^2/2\sigma^2}$	$e^{\mu+\sigma^2/2}$	$e^{2\mu+\sigma^2}(e^{\sigma^2}-1)$
Exponential	$\texttt{dexp(x,}\lambda\texttt{)} = \lambda e^{-\lambda x}$	$1/\lambda$	$1/\lambda^2$
Gamma	$\texttt{dgamma(x,}\alpha\texttt{,rate=}\lambda\texttt{)} = \frac{\lambda^\alpha}{\Gamma(\alpha)}x^{\alpha-1}e^{-\lambda x}$	α/λ	α/λ^2
Weibull	$\texttt{dweibull(x,shape=}\alpha\texttt{,scale=}\beta\texttt{)} = \frac{\alpha}{\beta^\alpha}x^{\alpha-1}e^{-(x/\beta)^\alpha}$	$\beta\Gamma(1+\frac{1}{\alpha})$	$\beta^2\left[\Gamma(1+\frac{2}{\alpha})-\left[\Gamma(1+\frac{1}{\alpha})\right]^2\right]$
Beta	$\texttt{dbeta(x,shape1=}\alpha\texttt{,shape2=}\beta\texttt{)} = \frac{\Gamma(\alpha+\beta)}{\Gamma(\alpha)\Gamma(\beta)}x^{\alpha-1}(1-x)^{\beta-1}$	$\frac{\alpha}{\alpha+\beta}$	$\frac{\alpha\beta}{(\alpha+\beta)^2(\alpha+\beta+1)}$

Notes (These will not appear on the exam)

1. $\Gamma(x) = \int_0^\infty t^{x-1}e^{-t}\,dt$

   $\Gamma(x)$ can be evaluated using integration by parts, but you won't ever need to do that. This is taken care of for you in functions like `dbeta()`, `pbeta()`, etc. If you ever need just the value of $\Gamma(x)$ (for example, to get the mean of a Weibull distribution), you can use the function `gamma()` in R.

2. Exponential distributions are a special case of the Weibull distributions.

3. Exponential distributions are also a special case of the gamma distributions.

4. Geometric distributions are a special caes of the negative binomial distributions.