Exam II
Administered: Wednesday, February 28, 2001
28 points

For each problem part: 0 points if not attempted or no work shown,
1 point for partial credit, if work is shown,
2 points for correct numerical value of solution

Problem 1. (10 points)

We are developing a process where the quality of the feedstock is important. Poor quality feedstock can result in unacceptable product. A vendor for the feedstock provides us with 20 samples. He claims that the mean purity of the feed stock is 0.70 and claims that the standard deviation is 0.002. We run the 20 samples through our own lab and find a sample mean purity of 0.702 with a sample standard deviation of 0.003. Based on this information, answer the following questions.

(a) What PDF is appropriate for determining a confidence interval on the variance?
(b) Find the lower limit on a 96% confidence interval on the variance.
(c) Find the upper limit on a 96% confidence interval on the variance.
(d) Is the vendor's claim legitimate?
(e) If our maximum allowable standard deviation is 0.0045, can we be 96% confident that the vendor's feedstock is adequate?

Problem 2. (8 points)

We decide to test our statistics savvy with one of the stars of the UT Lady Vols basketball team. Having compiled a shooting performance database on this particular player over the course of the season, we discover that her free throw shooting percentage is 0.782. In an on-the-spot demonstration, we ask the Lady Vol to attempt 10 free throws.

(a) What PDF would describe the probability that she make at least 9 of the 10 free throws?
(b) What is the probability that the Lady Vol make at least 9 of the 10 free throws?
(c) What PDF would describe the probability that she misses her first free throw on her last attempt?
(d) What is the probability that the Lady Vol misses her first free throw on her last attempt?

Problem 3. (6 points)

In studying dot-com businesses, we find that, on average, a company started in 1997, had an operational life of 2.7 years, before filing for bankruptcy, with a standard deviation of 1.4 years.

(a) What is the probability that a dot-com company can continue to operate for more than 5 years?
(b) How long does it take for 25% of the dot-com companies to fail?
(c) What PDF did you use to solve (a) & (b)?

Problem 4. (4 points)

The enthalpy of an ideal binary mixture can be approximated as the sum of the two pure component enthalpies, weighted by their respective mole fractions:

$$H_{mix} = x_1 H_1 + (1-x_1) H_2 = x_1 C_{p,1}(T - T_{ref}) + (1-x_1) C_{p,2}(T - T_{ref})$$

where x_1 is the mole fraction of component 1, $C_{p,1}$ is the heat capacity (assume it to be a constant) of component 1, T is the temperature, and T_{ref} is a reference temperature.

We have pure component heat capacities, empirically fit to data at the reference temperature, where our data yielded variances of $\sigma^2_{C_{p,1}}$ and $\sigma^2_{C_{p,2}}$.

What is the variance of the enthalpy of the mixture at composition x_1 and temperature T?