1. Thicknesses of $n = 6$ sheets of wallboard before and after drying during manufacture, corresponding differences, and some summary statistics are below. (Units are inches.)

<table>
<thead>
<tr>
<th>Board</th>
<th>Before ($x$)</th>
<th>After ($y$)</th>
<th>Difference ($d$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>.514</td>
<td>.510</td>
<td>.004</td>
</tr>
<tr>
<td>2</td>
<td>.505</td>
<td>.502</td>
<td>.003</td>
</tr>
<tr>
<td>3</td>
<td>.500</td>
<td>.493</td>
<td>.007</td>
</tr>
<tr>
<td>4</td>
<td>.490</td>
<td>.486</td>
<td>.004</td>
</tr>
<tr>
<td>5</td>
<td>.503</td>
<td>.497</td>
<td>.006</td>
</tr>
<tr>
<td>6</td>
<td>.500</td>
<td>.494</td>
<td>.006</td>
</tr>
</tbody>
</table>

| Mean   | .5020      | .4970      | .0050            |
| Std dev| .0078      | .0082      | .0015            |

**a)** What 6 ordered pairs would be plotted on ordinary graph paper to make a normal plot for the "Before" data? (List the 6 numerical ordered pairs.)

**b)** With $\alpha = .05$, is there sufficient evidence to force the conclusion that drying provides a consistent reduction in thickness? (Show the whole 7 format.)
c) Give 95% two-sided confidence limits for the mean "After" thickness of these sheets of wallboard. (Plug in completely, but you don't need to simplify.)

7 pts

d) Give a 90% upper confidence bound for the standard deviation of "After" thicknesses of these sheets of wallboard. (Plug in completely, but you don't need to simplify.)

7 pts

e) Give two-sided limits that you are 95% sure bracket the next reduction in thickness by drying of one of these manufactured boards on the day of data collection. (Plug in completely, but you don't need to simplify.)

7 pts
At a later date a second sample of $m = 10$ boards was measured after drying with the results that sample average thickness was .4950 inch and sample standard deviation of thickness was .0102 inch.

**f)** Give two-sided 90% confidence limits that can be used to investigate the possibility of change (from the process conditions represented at the beginning of this problem) in consistency of wallboard thickness. (Plug in completely, but you don't need to simplify.)

**g)** Give two-sided 95% confidence limits for any change in mean thickness of the boards between the day represented at the beginning of the problem and the day represented in the summaries at the top of this page. (Plug in completely, but you don't need to simplify.)

**h)** If finished boards are to be visually inspected for serious surface abrasions, what sample size do you recommend to produce a 95% interval for the fraction of blemished board with end-points $\hat{p} \pm 0.02$?
2. (The following is a problem about the concepts of hypothesis testing. It is not an application of the any of the standard inference methods outlined on the inference summary sheets.)

A production process is physically stable and produces a fraction $p$ of nonconforming items. (We use a Bernoulli process model for describing successive items produced.) A process engineer begins observing production, and

$$X = \text{the number of items inspected through the first non-conforming item}$$

(Note that a Geometric distribution is relevant here.) This engineer wants to be able to detect the possibility that $p > .01$.

a) First suppose that the engineer will reject $H_0: p = .01$ if $X \leq 100$.

i) What value of $\alpha$ is this engineer using?

7 pts

ii) What is the probability of a Type II error if in fact $p = .02$?

7 pts

b) What $p$-value would be associated with an observation $X = 50$?

6 pts
3. The time required to service a customer arriving at a teller station in a certain bank is reasonably modeled as Exponential with mean 1.0 minute. Approximate the probability that the next 30 customers arriving at this station require more than 36 minutes total to service. (This is a probability problem, not a statistical inference problem. Hint: What is the average time per customer associated with a total of 36 minutes?)

3. Here are five 2-point True/False Questions. Write T or write F in the blank in front of each one.

_____ If a 90% confidence interval for $\mu$ is (31.2, 45.7), then the probability that $\mu$ lies between 31.2 and 45.7 is .9.

_____ If a 90% confidence interval for $\mu$ is (31.2, 45.7), then $H_0 : \mu = 50.0$ can be rejected in favor of $H_a : \mu \neq 50.0$ with $\alpha = .1$.

_____ A 95% prediction interval is meant to bracket 95% of all future observations from the sampled population or process.

_____ As sample sizes increase, the widths of tolerance intervals shrink to 0.

_____ The confidence level for a confidence interval is a kind of reliability measure, and the size of the interval is a type of precision measure.