Final Exam

December 18th, 1998

Answer each of the questions in the exam books provided. There are 100 total points. Read
the questions carefully and keep your answers brief and to the point. PLEASE WRITE
NEATLY, AND SHOW ALL THE WORK. Good luck!

Question 1. [10 points]

The breakdown of workers in a particular state according to their political affiliation and
type of job held is shown here. Suppose a worker is selected at random within the state and
the worker's political affiliation and type of job are noted.

<table>
<thead>
<tr>
<th>POLITICAL AFFILIATION</th>
<th>White Collar</th>
<th>Democrat</th>
<th>Independent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Republican</td>
<td>18%</td>
<td>8%</td>
<td>4%</td>
</tr>
<tr>
<td>Blue Collar</td>
<td>25%</td>
<td>36%</td>
<td>9%</td>
</tr>
</tbody>
</table>

(a) (3 points) Find the probability that the worker is not an independent.
(b) (3 points) Find the probability that the worker is a white collar worker, affiliated with
the Democratic Party.
(c) (4 points) Given that the worker is a Democrat, what is the probability that the worker
holds a blue-collar job.

Question 2. [10 points]

Transportation officials tell us that 60% of the population wear their seat-belts while
driving. A random sample of 800 drivers has been taken.
(a) (5 points) Calculate the approximate probability that more than half were wearing their
seatbelts.
(b) (5 points) What is the approximate probability that fewer than 300 drivers in the sample
had their seatbelts on?
Question 3. [30 points]

The government states that on average the unemployed find a new job after 6 weeks out of work. An independent study is commissioned which samples 100 unemployed individuals and reports that the mean length of unemployment in the sample is 39 days. Suppose it is known that the variance in the number of days unemployed is $\sigma^2 = 36$.

(a) (10 points) Construct a 95% confidence interval for the mean length of unemployment in the population. What assumptions or theorems do you base your conclusions on?

(b) (10 points) Perform a statistical test, at the 5% significance level, of the null hypothesis that the government claim is correct, against the alternative that the mean unemployment length is lower than what the government claims.

(c) (10 points) Describe in words the Type I and Type II errors in this context. What is the probability of a Type I error here?

Question 4. [30 points]

A firm which previously only advertised its product at the national level, conducted an experiment to determine whether local advertising can increase the total amount sold of its product. Twenty cities were randomly selected where the product was advertised in the local newspapers for a month. After the advertising campaign, sales were measured in the 20 cities. The experiment yielded a sample mean number of items sold equal to 645, and a sample standard deviation equal to 152.

(a) (10 points) Construct a 95% confidence interval for the mean sales in the 20 cities. What assumptions or theorems do you base your conclusions on?

(b) (10 points) Suppose that the average number of items sold by the firm nationally is 548. State the null and alternative hypotheses about the effects of local advertising.

(c) (10 points) Carry out the test for the hypothesis stated in part (b), at the $\alpha = 0.01$ significance level.

Question 5. [10 points]

A University Dean is interested in determining the proportion of students who receive some sort of financial aid. Rather than examine the records for all students, the dean randomly selects 200 students and finds that 118 of them are receiving financial aid.

(a) (5 points) Build a 95% confidence interval for the fraction of students receiving aid in the population.

(b) (5 points) Suppose the dean wants to estimate the proportion of all students receiving aid to within 2% (that is the size of the whole interval), with 99% confidence level. How many students would we need to sample?
Question 6. [10 points]

In a wage discrimination case involving male and female individuals, independent samples of male and female employees in similar positions provided the hourly wage results shown below. The null hypothesis is that male employees have a mean hourly wage less than or equal to that of female employees. Test the hypothesis with $\alpha = .01$. Does wage discrimination appear to be present in this case?

DATA:

<table>
<thead>
<tr>
<th></th>
<th>Male employees</th>
<th>Female employees</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>44</td>
<td>32</td>
</tr>
<tr>
<td>sample mean</td>
<td>$9.25$</td>
<td>$8.70$</td>
</tr>
<tr>
<td>sample std. Dev.</td>
<td>$1.00$</td>
<td>$0.80$</td>
</tr>
</tbody>
</table>