Part I. (25 points) A random survey of 120 people showed that 78 of them favor gun control (control= limitation) in the society.

1. (8 points) Construct a 99% confidence interval for the true percentage of people who favor gun control.

$\hat{p} = \frac{78}{120} = 0,65$

$SD = \sqrt{0.65 \times 0,35} = 0,476$

$SE = \sqrt{\frac{0.65 \times 0.35}{120}} = 0,0435$

$z = 2,6$

$CI: 0,65 \pm 2,6\ (0,0435)$

$CI = [0.537, 0.763]$

2. (3 points) Does the interval you have constructed in question 1 cover the true percentage? Explain.

It covers the true percentage with probability 0.99

It probably does but we are not sure.

3. (3 points) If 30 independent random samples are drawn from this population, and 30 different 99% confidence intervals are constructed, how many of these intervals are expected to contain the true percentage?

$30 \times \frac{99}{100} = 29.7$ About 29-30 of them.

4. (11 points) Test if more than half of all people in the population favor gun control. Show all steps and state your conclusion in plain English.

$H_0: p = \frac{1}{2}$

$H_a: p > \frac{1}{2}$

$SE = \sqrt{\frac{0.5 \times 0.5}{120}} = 0,0456$

$z = \frac{0.65 - 0.5}{0.0456} = 3.29$

p-value: $\frac{100 - 99.9}{2}\ \% = 0,025\ \%$

We reject H_0. There is significant evidence that morethan half of all people favor gun control

Part II. (20 points) The following are indices obtained by studying an Egyptian 847-year historical record of Nile River's overflows (overflow = taşma).

83.04, 77.90, 90.05, 87.67, 60.56, 70.17, 69.65, 85.10, 78.25, 59.42, 60.40, 71.43, 51.84, 76.77, 91.41, 66.25, 83.64, 83.51, 74.41

The greater this index, the higher the damage caused by an overflow.

Here is a MINITAB output for this data set

Variable	N	Mean	SE Mean	StDev	Minimum	Median	Maximum
C3	19	74.81	2.61	11.39	51.84	76.77	91.41

1. (4 points) In order to perform an appropriate hypothesis test, indicate the two assumptions you have to make in this problem.

   i. The records form a random sample (independent).

   ii. The observations follow a normal curve (at least approximately).

2. (13 points) Perform a hypothesis test at <u>1% level of significance</u>, for the claim that the index of Nile River overflows is greater than 70. Show all steps and state your conclusion in plain English.

$H_0: \mu = 70$

$H_a: \mu > 70$

$$t = \frac{74.81 - 70}{2.61} = 1.843$$

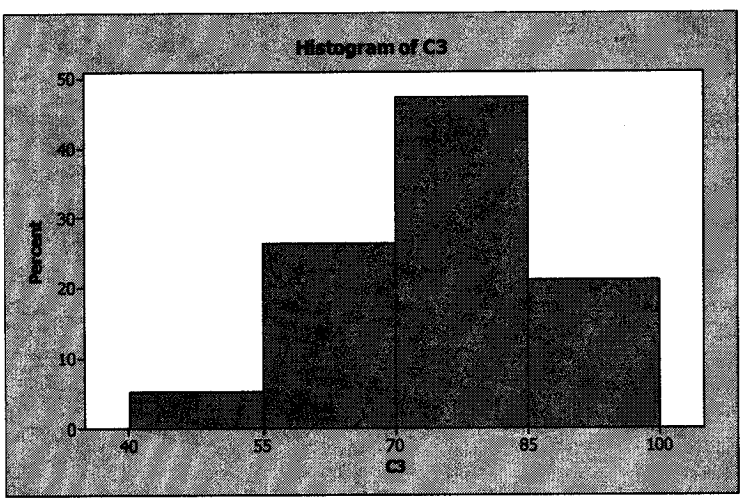
deg. of freedom $= 19 - 1 = 18$.

$1\% < \text{p-value} < 5\%$.

we do not reject at 1% level of significance.

The data doesn't support that the index of overflows are greater at 1% level of significance.

3. (3 points) Here is a histogram of the indices. Does it support your assumption(s) of question 1?



Yes, it's shape is similar to normal curve.

Part III. (25 points) An article that appeared in Journal of Cross-Cultural Psychology in 1991 reported a "boredom" scale (the larger the score, the more the boredom). In a random sample of 97 male and 148 female students, the following statistics have been obtained

	Sample Mean	Sample Standard Deviation
Males	10.40	4.83
Females	9.26	4.68

1. (8 points) Construct a 90%-confidence interval for the average boredom score of females in the population.

$$SE = \frac{4.68}{\sqrt{148}} = 0,385$$

$$CI: \quad 9,26 \pm 1,65 \ (0,385) = [8.625, 9.895]$$

2. (17 points) In general, are male college students more easily bored than their female counterparts? Answer by performing a test of significance; show all steps and state your conclusion in plain English.

$H_0: \mu_M - \mu_F = 0$

$H_1: \mu_M - \mu_F > 0$

$$SE = \sqrt{\frac{(4.83)^2}{97} + \frac{(4.68)^2}{148}} = 0.623$$

$$z = \frac{10.4 - 9.26}{0,623} = 1,83 \approx 1.85$$

$$p\text{-value} = \frac{100 - 93.57}{2} = 3,21\ \% < 5\ \%$$

We reject H_0.

Male college students are significantly more easily bored than their female counterparts.

Part IV. (15 points) An Internet service provider (=a company; ISP in short) aims to provide a large enough telecommunication network so that the customers rarely encounter a busy signal when they make a call to connect to the Internet. The company guarantees that the chance that a customer encounters a busy signal is only 8% on a given call.

A customer of this ISP calls once a day and every day in a given week. Assume that calls on consecutive days are independent.

1. (3 points) What are the chances that the customer encounters no busy signals in that week?

$P(0) = (0,92)^7 \cong 0,558$

2. (7 points) What are the chances that she encounters at least 2 busy signals in that week?

$P(2 \text{ or more}) = 1 - P(0) - P(1)$

$= 1 - 0,558 - 0,339$

$= 0,103$

$P(0) = 0,558$

$P(1) = \binom{7}{1} (0.08)^1 (0.92)^6$

3. (5 points) If she indeed encounters 2 busy signals in that week, would she believe the ISP's claim that the busy signal occurs with a chance of only 8%? Hint: Use your answer to Question 2; no need to do calculations here.

$0,103 = 10\% > 5\%$

Do not reject H_0 in the following test of hypotheses.

H_0: $p = 0,08$

H_a: $p > 0.08$

where p is the percentage of busy signals for this ISP.

Part V. (15 points) Blood type varies among different populations of people. In the United States, types 0, A, B, and AB blood make up 45%, 40%, 10% and 5% of the population, respectively. Suppose blood type is determined for a sample of 200 individuals in Turkey resulting in the following distribution:

0	A	B	AB	Total
82	73	29	16	200

1. (10 points) Is the blood type distribution in Turkey significantly different from US? Show all steps of a hypothesis test and state your conclusion in plain English.

	O	A	B	AB
observed values:	82	73	29	16
expected values:	90	80	20	10

$\chi^2 = \frac{8^2}{90} + \frac{7^2}{80} + \frac{9^2}{20} + \frac{6^2}{10} = 8.97$ d.f. = 4 - 1 = 3

$7.82 < 8.97 < 11.34 \Rightarrow 1\% < \text{p-value} < 5\%$

So, we reject H_0.
The blood type distribution in Turkey is significantly different from US.

2. Answer the following:
   a) (2 points) What is the variable in this question?

      Blood type

   b) (1 point) Circle the correct choice: (i) qualitative or ii) quantitative ?

   c) (2 points) What are the values of this variable?

      A
      B
      O
      AB