

## Homework 2

Due October 2

1. (2 points) Mensa is an international society whose membership is limited to persons having IQs above the general population's 98th percentile. It is well known that the average IQ for the general population is 100, the standard deviation is 16, and the distribution, itself, is normal. What, then, is the *lowest* IQ that will qualify a person to belong to Mensa?
2. (3 points) A cohort of hemophiliacs is followed to elicit information on the distribution of time to onset of AIDS following ser-conversion (referred to as *latency time*). All patients who seroconvert become symptomatic within 10 years, according to the following distribution:

Latency time (years)	Number of patients
0	2
1	6
2	9
3	33
4	49
5	66
6	52
7	37
8	18
9	11
10	4.

Assuming an underlying normal distribution, compute 95 % confidence intervals for the mean and variance of the latency times. Still assuming normality, estimate the probability  $p$  that a patients's latency time will be at least 8 years.

3. Assume the following data is given about the left ventricular ejection fraction (LVEF) for 27 patients with acute dilated cardiomyopathy:

Patient	LVEF	Patient	LVEF
1	0.19	15	0.24
2	0.24	16	0.18
3	0.17	17	0.22
4	0.40	18	0.23
5	0.40	19	0.14
6	0.23	20	0.14
7	0.20	21	0.30
8	0.20	22	0.07
9	0.30	23	0.12
10	0.19	24	0.13
11	0.24	25	0.17
12	0.32	26	0.24
13	0.32	27	0.19
14	0.28		

- (a) Calculate the standard deviation  $\sigma$  of LVEF for the 27 patients.
- (b) Calculate the standard error of the mean  $\mu$  for LVEF.
- (c) Find 95 %, respectively 99% CI for  $\mu$  and  $\sigma$  .
4. Derive the local form of the traffic conservation law for a street with entrances and exits.
5. (a) Many state laws say that for each 10 m.p.h. (16 km/h) of speed you should stay at least one car length behind the car in front of you. Assuming that people obey this law (i.e. **exactly one** length), determine the density of cars as a function of speed (you may assume the average length of a car is 16 feet (5 meters)). There is another law that gives a maximum speed limit (assume this is 50 m.p.h (80 km/h)). Find the flow of cars as a function of density.
- (b) The state laws described in part (a) were developed in order to prescribe spacing between cars such that rear-end collisions could be avoided. Assume that the car immediately ahead decelerates at rate  $\alpha$  and the driver following takes time  $\tau$  to react. How far back does a car have to be traveling at  $u$  m.p.h. in order to prevent a rear-end collision? (Do not ignore the length of a car,  $L$ ).
- (c) Show that the law described in part (a) corresponds to part (b) if human reaction time is about 1 second and the length of a car is about 16 feet (5 meters).