EPIB-621 Solutions 2007 Final Exam

1. (a) Use a t-test to calculate:

$$t = \frac{4.7 - 5.1}{3.1/\sqrt{100}} = -1.29$$

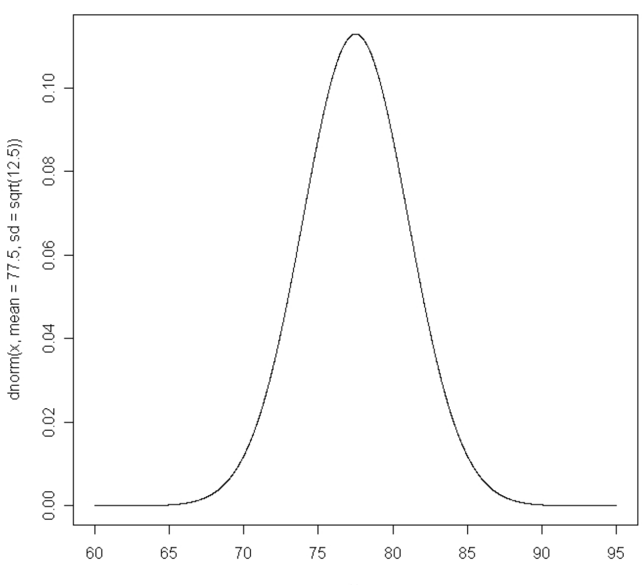
From t tables, we find $p = 0.197$ (one sided). So, no evidence to reject the null hypothesis.

(b) Using usual confidence interval formula for a mean, we calculate:

$$4.7 \pm 1.984 \times 3.1/\sqrt{100} \longrightarrow (4.08,\ 5.32)$$

Comparing this value to the previous mean of 5.1 days, we see that the CI covers both reductions of great interest (greater than one day), but also values of negligible interest (such as 0 difference from 5.1, and even increases in days absent). So, the sample size of 100 was not sufficient, as this confidence interval is inconclusive.

2. First, we calculate that the mean is the data is given by $\overline{x} = 80$. Then, using the formulae provided in the class notes (directly plugging in the relevant values given in the question to the formula given in the notes), we find that the posterior distribution is $N(\mu = 77.5, \sigma^2 = 12.5)$. A plot of this distribution is given below.



3. (a) Represents the number of frostbite cases at a temperature of zero, assuming that the regression line would still be valid in that range (however,

it is probably not valid, as it is out of range of the data, and there is probably little to no frostbite at zero degrees Celsius).

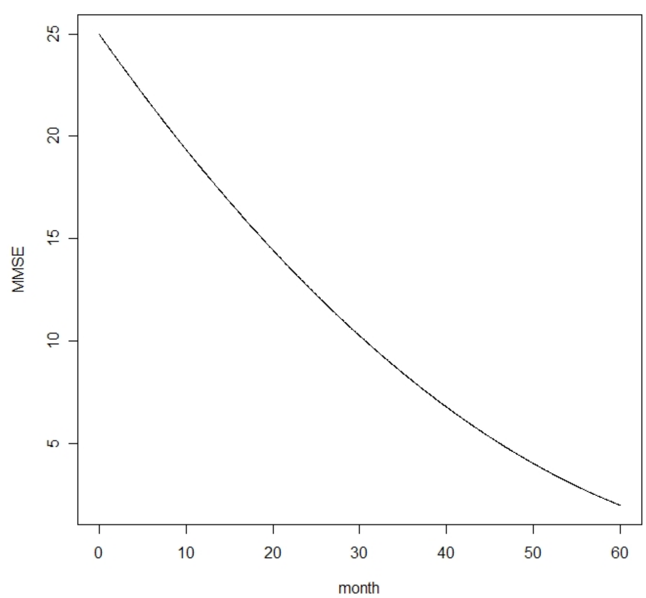
(b) Within the range under which the data were collected, this is the average change (here, a decrease) in the number of frostbite cases for each degree Celsius increase. In other words, for each degree increase, there is 0.25 fewer cases, or one less case for each 4 degree change.

(c) This statement is false. The equation could be correct, but one cannot extrapolate far out of the range of the data. The formula does not work here, but it is not *expected* to work this far out of range.

4. Squaring both sides of the equation, we see that

$$MMSE = 25 - .6 \times month + 0.0036 \times month^2$$

Plotting this, we get:



[Note: While the above graph is "exact", for exam purposes, any rough plot was sufficient. For example, without squaring the equation, one could take various points (three or fours points are sufficient) and simply "connect the dots" to get a rough plot.]

(b) Plugging into the equation from part (a), we get a prediction of

$$MMSE = 25 - .6 \times 12 + 0.0036 \times 12^2 = 18.32.$$

(c) False, as this is not the correct way to calculate a confidence interval for a prediction. For example, this calculation omits the uncertainty in the intercept, as it considers just the CI for the slope.

5. (a) Using the values found under the column "EV" in the R output (which provide the model averaged coefficients), we calculate

$$\text{logit of outcome} = 0.06077 + 0.0149 + 0.33514 = 0.41087.$$

Taking the inverse logit of this we calculate

$$\frac{\exp{(.4108)}}{1 + \exp{(.4108)}} = 0.6013$$

So, the predicted probability is 0.6013.

(b) Comparing models 2 and 4, we see that x_1 and x_2 are confounded.

(c) We calculate

$$OR = exp(.3409) = 1.41$$

and

$$exp(0.3409 \pm 1.96 \times 0.0868) \longrightarrow (1.19,\ 1.67)$$

6. Clearly, there will be very high confounding between all three variables, but not complete collinearity. If the goal of the model is prediction, it may be OK to put all three into the model, but using two of the three may do just as well. However, if the goal of the study is to find the effects of height and weight on the outcome, then one must be very aware of the possibly high confounding. It would not be sufficient to just run a single model with all three variables, and report the ORs from each, as these ORs will likely substantially change as other variables entered or exited the model.

7. (a) We can create the following table:

Variable	Conclusion
Weight gain	Huge effect, both univariate and multivariate
Long race time	On average an effect, but large variability, so little preictive power for individuals
BMI extremes	Not really both extremes, just low BMI has an effect
Female sex	Disagree with conclusion, may have an association, but perhaps strongly correlated with other variables
Fluid composition	Agree, poor choice of variable to use 100% water
NSAIDS	Disagree, inconclusive given small numbers

(b) The averages in both groups are similar only because of cancellation of differences between categories. So in this case, averages are misleading, one needs a more careful breakdown, as given by the categorical variable.

8. (a) Directly from the output for w, we see a point estimate of 0.053, with 95% credible interval of (0.027, 0.092).

(b) While there is some evidence for a difference between Regions 1 and 2, their CIs overlap, the the evidence in rather weak.