(1) (a) Slightly fatty liver:
@30: 1584*Liver + 1490*(1-Liver) = 1574 \rightarrow 94*Liver = 84 \rightarrow Liver fraction = 0.89; Fat fraction = 1-0.89 = 0.11.
Very fatty liver:
@34: 1589*Liver + 1390*(1-Liver) = 1524 \rightarrow 199*Liver = 134 \rightarrow Liver fraction = 0.67; Fat fraction = 1-0.67 = 0.32.

(b) \[
\Delta f (T) = \frac{1}{2d_0} \left[ \frac{dc(T)}{dT} \right]_{T=T_0} \Delta T - \alpha c_0 \Delta T
\]

we substitute 1mm for d0, 0.0001 for alpha, c0 = velocity at 30°C for each tissue type and delT = 7°C.
for example, dc/dT for normal liver is (1592-1584)/(37-30) = 1.14.
Results are: 3.45 KHz for normal liver, 2.95KHz for slightly fatty liver, 1.97KHz for very fatty liver.

(2) a) 

Estimated Temperature

![Graph showing estimated temperature vs sample number]

b) There is an ambiguity – two temperatures are possible for each measurement. This is because of the hydrogen bonding in water – it causes the compressibility to increase then decrease.
c) There is still some ambiguity between 2 and 3 but since it looks pretty linear we are probably safe to assume it is as shown above.

3) (b) shape of the heated area in the focal zone - oval; from the difference image you can see that the shape of the heated area in the near field is triangular.
(d) No, a lethal thermal dose is not achieved
(e) standard deviation should be calculated on the area within the imaged region in the difference image, outside of the heated region. This is an estimate of the noise of the temperature map.
(g) Motion, Field drift over time
(h) After heating, the region contains less water, thus we get reduced MR signal magnitude. Magnitude signal also changes because of T2, T1 changes and increases in diffusion
(i) Changes in state of the water result in hysteresis.

4) the optimal time to measure the signal is when it’s at its peak (this maximizes the SNR):

\[ \text{Signal} \propto TE \cdot e^{-\frac{TE}{T2}}. \]
Maximize the signal – we need to calculate the derivative of the signal w.r.t TE and set it to 0. We get TE=T2*. 