Calculus 2 - Feedback on Assignment 2

General Feedback

The mean mark was $\frac{13}{20}$ with a standard deviation of 3.6 marks.

Quite a few marks were missed by just not reading the question properly or providing what was actually being asked for. There was a certain amount of evidence of the use of Wolfram Alpha / Mathematica and such like. Please be very careful about this. These things are fantastic to help you understand and explore concepts but if you rely on them to do assignment work then they have the effect of making you think you understand more than you really do. I'm not a massive fan of calculating double integrals by hand either but the fact is you need to be confident doing this stuff in the exam. We learn a lot of maths by trying things by hand, getting them wrong, going down blind alleys, backing up to find mistakes etc.

Question 1(a) This was generally done very well. However lots of you actually did far more work than was necessary. See my solutions for the matrix method to find the vertices of P'.

An alternative would be to solve the change of variables $x = \frac{2u+v}{3}$ and $y = \frac{u+2v}{3}$ to give u and v in terms of x and y then substitute values for x and y for each vertex of P.

Several people instead did the substitution first then solved for u and v. This boils down to solving four pairs of simultaneous equations instead of one!

A few people found equations of the four straight lines bounding P and worked out how they transformed into the (u, v)-plane under the substitution. This is correct but again not necessary - the given substitution is *linear* and therefore transforms straight lines to straight lines. Therefore finding where the vertices go will suffice to find the shape of P'. Just join up the resulting vertices with straight lines.

Question 1(b) Most people got this right though some had $\frac{\partial(u,v)}{\partial(x,v)}$ instead of $\frac{\partial(x,y)}{\partial(u,v)}$. It's fine to do it that way round but then you need to turn the answer 3 upside down to get $\frac{1}{3}$.

Question 1(c) Generally very well done, a few slips evaulating the integral but otherwise fine. You don't need to give a numerical answer in calculus courses unless asked to, just leave it in a suitable algebraic form.

Question 2(a) I was amazed at the number of people who did not simply write down the coordinates of the other three vertices of the rectangle as requested in the question. Don't throw away easy points...

I was also surprised at how few people drew a picture. Drawing the rectangle inside the ellipse should make it easy to notice two extreme points. When the rectangle is tall and thin, $x = 0,\ y = b$, we expect the area to go to zero. Similarly when it is short and wide, $x = a,\ y = 0$.

As I said in the feedback to assignment 1, it is almost always a good idea to draw a sketch.

Everyone knows the formula for the area of a rectangle, I was pleased to see.

Question 2(b) No-one got this question entirely right. Most were able to set up the Lagrangian function and find the stationary point $(\frac{a}{\sqrt{2}}, \frac{b}{\sqrt{2}})$ however *no-one* checked if this corresponded to a maximum or minimum point.

A lot of people who found this point didn't actually calculate the area using their function $f(x, y)$. Don't forget that optimising a function involes both finding the point where the optimal value occurs *and* evaluating the function itself at that point.

No-one found the stationary points $(a, 0)$ & $(0, b)$ mentioned above. (Actually as I type this I realise I did not list them explicitly myself in my solutions on moodle - let's consider this a correction!).

Question 2(c)i,ii,iii Pretty good. Most people were able to make the change of variables and find the area of the ellipse. When changing to polar coordinates you don't need to calculate the Jacobian explicitly. It's such a common substitution that it's fine just to put in $rdrd\theta$ in the double integral.

Despite working out the area properly hardly anyone answered part iii in a meaningful way. The phrase "at most" means use a "$\leq$" sign.

Question 3(a) Great, almost everyone got this right.

Question 3(b)i A couple of people really nailed this. Most others knew it was true but could not give a valid argument. A lot of you said that since the determinant for the Hessian matrix is positive for f and g then it must be positive for $f + g$. This is actually not obvious and although true its proof is well beyond the scope of any linear algebra we know. The proof from the definition of local minimum is much more straightforward and actually more convincing.

Question 3(b)ii Fewer people had a good answer here. Really the point of this question was to get you playing with functions of two variables, sketching them on GeoGebra etc and trying to build some intuition.

Question 4 This was the worst answered question. A few of you have told me you didn't get the chain rule for partial derivatives when it was covered in lectures. So I think we should definitely go over it again in the revision lectures. In the meantime I'll post some video tutorials on the topic on the course page.