ASEN 5005-Statistical Orbit Determination Homework 4

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1 Problem 1

Given the joint density function:

$$f(x,y) = k * (x^2 + y^2) \quad 0 < x < 2, \quad 1 \le y \le 3$$
$$f(x,y) = 0 \quad elsewhere$$

Several insights were to be found.

1.1 1a-Find k

To find **k**, I employed the rule that any joint density function must be equal to one when integrated across the number range.

$$\int_{-\infty}^{\infty} \int_{-\infty}^{\infty} k * (x^2 + y^2) dx dy = 1 \tag{1}$$

Since the validity of the function was limited to a specific number range for each variable, the joint density function becomes:

$$\int_{1}^{3} \int_{0}^{2} k * (x^2 + y^2) dx dy = 1 \tag{2}$$

First, I integrated with respect to **x**

$$k * \int_{1}^{3} (\frac{x^3}{3} + x * y^2) \Big|_{0}^{2} dy = 1 \tag{3}$$

Then after evaluating for the **x** range, I integrated with respect to **y**

$$k * \left[y * \frac{8}{3} + 2 * \frac{y^3}{3} \right] \Big|_{1}^{3} dy = 1 \tag{4}$$

Which evaluates down to

$$k * \left[22.67 \right] = 1 \tag{5}$$

Yielding a final value of

$$k = 0.0441 \tag{6}$$