

**Exercise 1 - JPDF of Wishart Laguerre ensemble for  $\beta = 2$** 

Derive the jpdf of eigenvalues of  $W$  of the Wishart Laguerre ensemble for  $\beta = 2$ , where the Wishart matrix  $W = HH^\dagger$  is  $N \times N$  dimensional and  $H$  is  $N \times (N + \nu)$  dimensional, with all elements of  $H$  being independent.

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**Exercise 2 - Marcenko-Pastur density**

Check the following two integral identities:

- For  $b > a$  we have

$$\int_a^b dx \frac{\sqrt{(x-a)(b-x)}}{2\pi x} = \frac{1}{4} (-2\sqrt{ab} + a + b) \quad (1)$$

- The integral  $\int dx \rho(x)/x$  amounts to computing

$$\int_a^b dx \frac{\sqrt{(x-a)(b-x)}}{2\pi x^2} = \frac{-2\sqrt{ab} + a + b}{4\sqrt{ab}}$$

Furthermore derive the normalization constant for the Marcenko-Pastur density  $K$  to be  $K = 1/\gamma$  where  $\gamma = (1-c)/c$ , and express the endpoints of support through  $c$ , using the notations from the lecture notes.

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