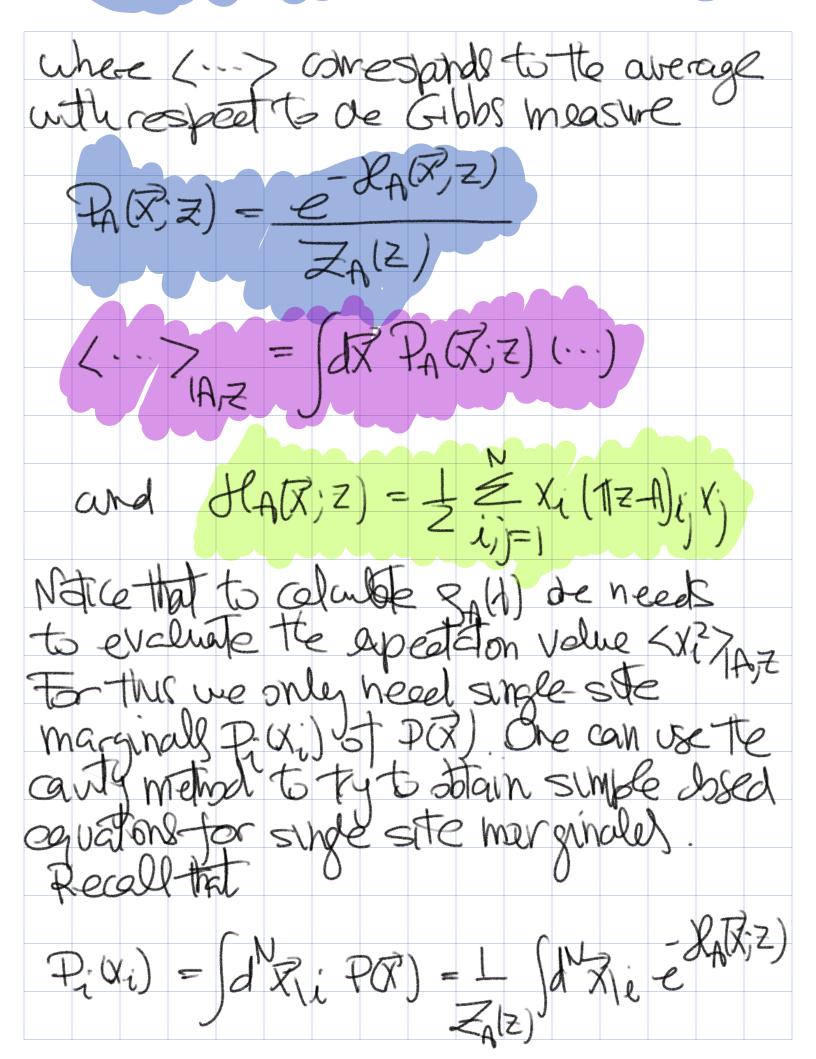
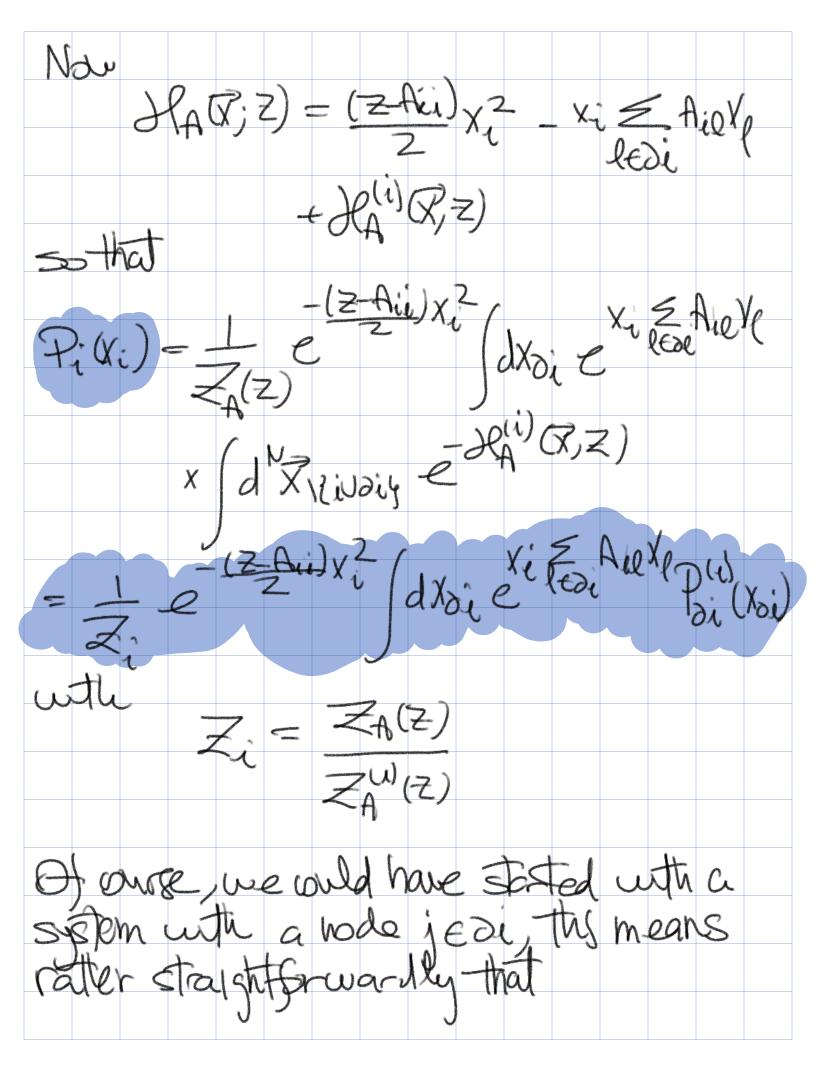
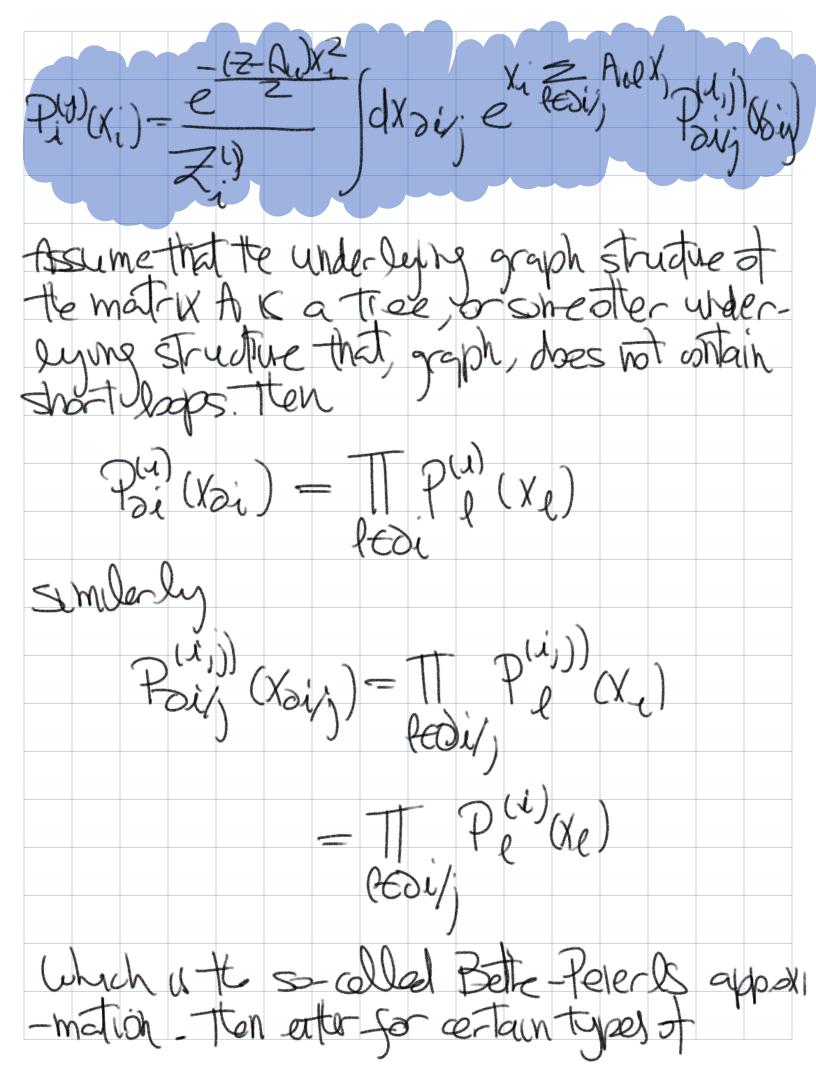
Mappmgt Consider an ensemble 2 of NXN real Symmetric matrices and let ACE Dende a TA = (Si, ..., di) - te speatrum of A. Define the empirical speatral density, gren A. a. th, as SAH)=NZSH-LA) SALL ander elated to a local to some nelated to a flemationian for which the matrix entres of A play He role of exchange carplings. $S_A(d) = \frac{1}{NTT} \lim_{R \to 0^+} \lim_{i=1} \lim_{A \to 1^+} \frac{1}{1-A_i} \frac{1}{2}$ = $\lim_{X \to 0^+} \lim_{Z \to 0^+} \frac{\partial}{\partial z} = \log(z - d_i^A)$ NIL $z \to 0^+$ $\partial z = 1 = 1$ N $|z = d - \frac{1}{2}$ = lim tim d bg[T[Z-di]] NT 200 DZ bg[T[Z-di]]

 $= \frac{1}{N\pi} \lim_{z \to 0} \lim_{z \to 1} \lim_{z \to 1} \frac{1}{2} \log \det(\Pi z - A) |$ $= \frac{2}{N\pi} \lim_{z \to 0} \lim_{z \to 1} \lim_{z \to 0} \frac{1}{2} \log \frac{1}{\sqrt{2\pi}} |$ $= \frac{2}{N\pi} \lim_{z \to 0} \lim_{z \to 1} \frac{1}{2\pi} \log \frac{1}{\sqrt{2\pi}} |$ Introduce the "portition function" $Z_{A}(z) = \left(d^{N} \overline{z} \right) \left[-\frac{1}{2} \overline{z}^{T} (\overline{z} - A) \overline{z} \right]$ with $\overline{X} = (X_1, X_N)$ tten $= -\frac{2}{Ntt} \lim_{\substack{x \to 0}} \lim_{\substack{x \to 0}} \lim_{\substack{x \to 0}} \frac{1}{2} \lim_{\substack{x \to 0$ (H) Notice that from the paint of view of stat. mech, we have that SAH) = 1 lim Im Z < X2 / IAZ / Z-1-12







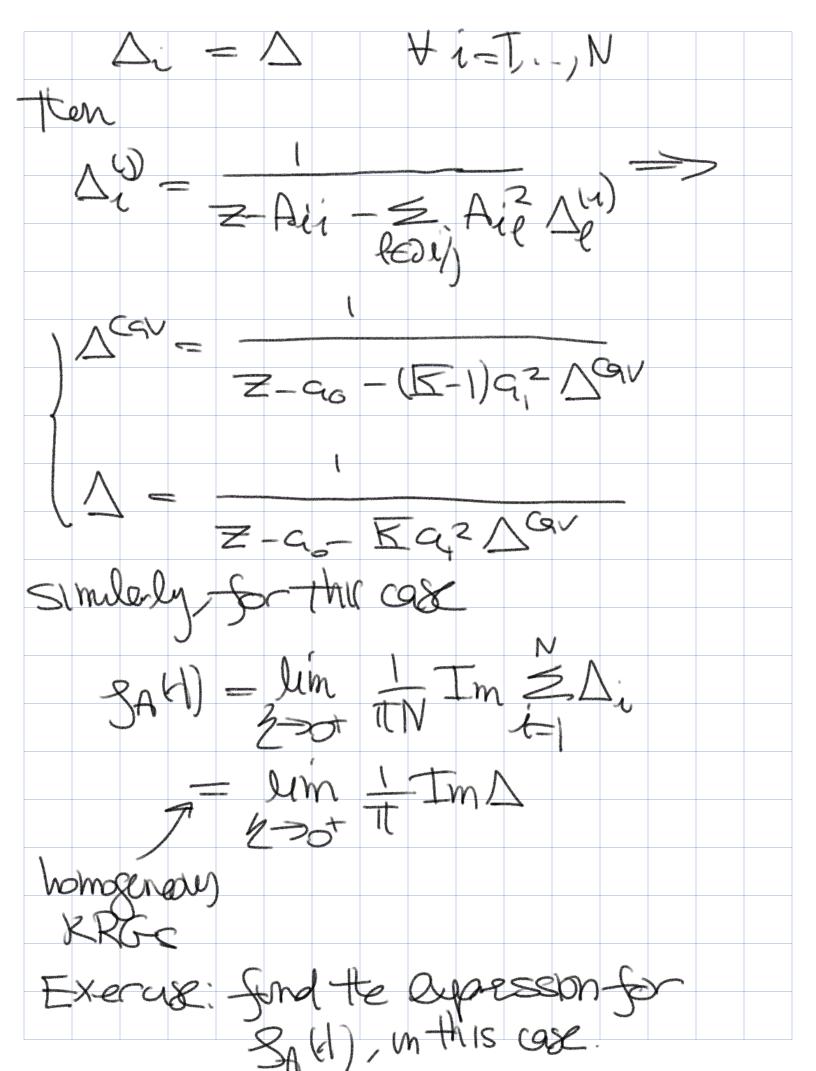
matrices or with this approximation we can unde close equations for single-stemarg-hals $P_{i}(x_{i}) = \frac{-(z-A_{i})x_{i}^{2}}{Z_{i}} \quad \text{Therefore } x_{i}A_{i}e^{\chi_{e}} P_{e}^{(i)}(x_{e})$ $= \frac{-(z-A_{i})x_{e}}{Z_{i}} \quad \text{fedi} \quad \text{for } e^{\chi_{i}}A_{i}e^{\chi_{e}} P_{e}^{(i)}(x_{e})$ $= \frac{-(z-A_{i})x_{e}}{Z_{i}} \quad \text{for } e^{\chi_{i}}A_{i}e^{\chi_{e}} P_{e}^{(i)}(x_{e})$ $= \frac{-(z-A_{i})x_{e}}{Z_{i}} \quad \text{for } e^{\chi_{i}}A_{i}e^{\chi_{e}} P_{e}^{(i)}(x_{e})$ nals Li=T. N li=T. N i=T. 1001 Notice that in this ase the set of carity opicions involve single-ste marginals with ashtinudes variables. So in principle, yell need an intrate number of perameters, to fully character petter. In this care, have -, one realized that the cauty maginals have a Gaussian form, this form is preser ved under the cauty equation. Let us ten

 $P_{i}^{(P)}(x_{i}) = \frac{1}{\sqrt{2\pi}\Delta_{i}^{(P)}} e^{-\chi_{i}^{(P)}} \frac{1}{\sqrt{2\pi}\Delta_{i}^{(P)}} \frac{1}{\sqrt{2\pi}\Delta_{i}^{(P)}}$ unde $P_{i}(x_{i}) = \frac{1}{\sqrt{2\pi\Delta_{i}^{2}}} e^{-x_{i}^{2}/2\Delta_{i}} \int_{1}^{\Delta_{i} \in \mathbb{C}} \frac{\Delta_{i}}{\sqrt{2\pi\Delta_{i}^{2}}}$ and similarly than the previous set of cavity equations beuhe Z-ALI-ZAZALI) REDIVI jedi 1=1,..., Carity equations for the parameters $\{\Delta_{i}^{(j)}\}_{i=1,\dots,N}$ Lo Once you have the station to this set of equators, numerically or derrule, we

have totain tevalues ALAilt=1,...,N Z-Aii - Z Aie De Once we have the values of I Sili-I. N Then the spectral density can be explored as fillers First notice that $\langle X_i^2 \rangle = \int dX_i P_i(X_i) X_i^2$ $= \int \frac{dx_i}{\sqrt{2\pi}} e^{-x_i^2/2\lambda_i} x_i^2 = \Delta_i$ Thus $|S_A(t)| = \frac{1}{\pi N} \lim_{z \to 0^+} \frac{1}{t-1} \lim_{z \to 0^+} \frac{1}$ So the abor them to stimule the spectral density S(H) of a given matrix A do the Solaring

I Thitely (AN) JEDU ANEL TO 2. Take a value of delk and small value of y and introduce Z=dig 4. Obtain the values of [Di] using 5 Dotte operation N SA(1) & The EIm Ai 6. repeat te process changing te value of

1 This will given either an apposition to S(1) or the exact expression for a certain ensembles = 3t matrices In some cases the set of cavity equations Can be shed applicitly. Indeed, while The ensemble of homoseneous random hegular graphs. These are graphs where The degree it each when the same and te unks between no des have the same Value. Suppose then homogeneous random vegule graph with weights Aii = ao, Ai, = an i+j and degree I. Since these graphs $\Delta_{1,i}^{(\gamma)} = \Delta^{(\alpha)} \qquad \forall i = T_{i}, N_{j} \in \partial I$



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