Assignment 2

1. Consider a 2 dimensional PLCP Φ_S which is defined on a PLP ϕ_L. The intensity of the generating process for the PLP is λ_R and that of the one dimensional PPP is λ_S.

   (a) What is the intensity measure of the unit ball, $\mathcal{B}(0,1)$? **[1 point]**

   (b) Derive the void probabily of the unit ball. **[1 point]**

   (c) Consider now the ball $\mathcal{B}(0,R)$. What is the expected value of the sum of distances of all points $\{x : x \in \phi_S \cap \mathcal{B}(0,R)\}$? **[3 points]**

2. Let us consider a two tier network consisting of MBSs and SBSs. The location of the MBSs are modeled as a homogeneous PPP ϕ_M with intensity λ_M. The locations of the SBSs are modeled according to a PLCP with parameters λ_S and λ_R. The typical user is at the origin. The transmit powers of the two tiers are P_M and P_S respectively. The path-loss coefficient is K and the path-loss exponents are α_M and α_S, respectively.

   (a) Derive the association probabilities for the two tiers. **[2 points]**

   (b) Plot the association probabilities with varying λ_S for $P_M = 40$ dBm, $P_S = 10$ dBm, $\lambda_R = 0.1$ m^{-1}, $\alpha_M = \alpha_S = 2$, $\lambda_M = 1e-5$ m^{-2}. The propagation parameters are same as Assignment 1. **[3 points]**

3. Let us consider a SBS tier, with the BS locations modeled as a PLCP. The SBSs are capable of transmitting in both sub-6GHz and mm-wave bands. Let us consider that the users are also located along the roads. A BS is considered to be in LOS with respect to a user if and only if it is located in the same street as that of the user. That is, for a user, all the BS in the same street as that user are in LOS. All other BSs are in NLOS. The transmit power is P_S. The propagation parameters are as before. The path-loss exponents are α_L and α_N for LOS and NLOS, respectively for mm-wave, and α_μ for sub-6GHz. The antenna gain in mm-wave is G.

   (a) Evaluate the association probabilities with the LOS and the NLOS tier when the association takes place in the sub-6GHz band. Assume max-power association. **[2.5 points]**

   (b) Once the association occurs, the user has to select the band. Suppose that the user selects and LOS BS, what is the probability that it selects the mm-wave band? Assume max-power selection as was discussed in class previously. **[2.5 points]**