

WINTER 2023 MATHEMATICS UNDERGRADUATE SEMINAR

WQ23 MATH 105-6 Instructor: Prof. Nir Avni

- *Probabilistic Heuristics*
- *Checking Degenerate/extreme cases*
- *Symmetry and Dimensional Analysis*
- *Counting Degrees of Freedom*
- *Fermi Problems*
- *Computer Experiments*

BACK-OF-THE- ENVELOPE MATHEMATICS

$r^2 = \frac{a^2 + b^2}{2}$

$\log(n!) = \sum_{k=1}^n \log(k) \sim \int_1^n \log(x) dx = n \log n - n \Rightarrow n! \sim \frac{n^n}{e^n}$

$\int_{-1}^1 (\cos t)^{100} dt \approx \frac{\sqrt{2}}{10} \int_{-\infty}^{\infty} e^{-s^2} ds$

$\frac{D}{d} = \left(\frac{\text{Period}_{\text{Ext}}}{\text{Period}_0} \right)^2$

Prerequisites for this Course:

- High School Geometry and Algebra
- Calculus
- Probability
- Some Familiarity with a Scripting Programming Language



The emphasis in most upper level math classes is to train you in finding a proof for a precise mathematical statement. Very little attention is given to how you would guess such a statement. The purpose of this seminar is to teach you some of the heuristics we use when looking for mathematical statements that have a chance to be true.