Department of Mathematics

May 23, 2008

UNDERGRADUATE MATHEMATICS SEMINAR

The next seminar (the last one of the term!) will be this coming **Monday, May 26th,** with refreshments beginning at **4:00** in the Math Common Room, **Bailey 204**, and the talk following at **4:15** in **Bailey 207**.

In this seminar**, Leon Tatevossian** will be presenting the following talk:

TITLE: **From Academia to Wall Street: The Mathematics of Credit Default Swaps**

ABSTRACT: The credit default swap (CDS) is a contract in which one party transfers the risk of default to the other party. The first CDS transactions took place in the early 1990's, and the market has exhibited tremendous growth in the last several years. The CDS is the building block of the credit derivatives market in much the same way that the interest rate swap is the building block of the interest rate market. Price changes in the CDS market have been an important indicator of market sentiment during the credit crisis that began in mid-2007.

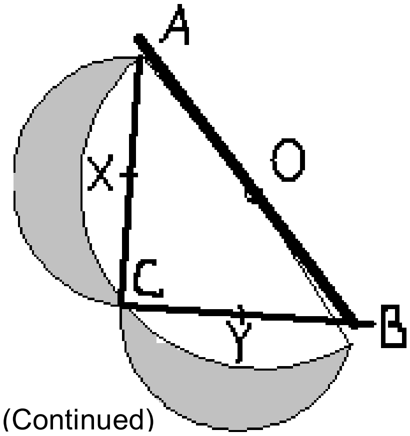
We'll explain the basic mechanics of CDSs and discuss the link between CDSs and more complicated credit-derivative transactions, including "basket" credit derivatives. We'll put the risks of CDSs in the context of risk measures in the interest rate market. For the modeling of basket derivatives, a standardized model was implemented. Efforts to understand breakdowns in the model are an important work-in-progress in credit derivatives research.

About the Speaker**:** ***Leon Tatevossian was an instructor in Union's Mathematics Department from 1985-88. In 1989, he moved to Wall Street when he joined the Financial Strategies Group in the Fixed Income Division at Morgan Stanley. Over the past nineteen years, he has worked at several major banks and investment banks as a quantitative analyst, fixed-income trader, and risk manager.***

Pieces from Theses: A View from Laura Hutchinson ('08)
Ruler and Compass Geometry: Possibility and Impossibility

This thesis addressed the method of solving geometric problems using a straightedge and a circle-making device, a ruler and a compass. The ancient Greeks used this system when they began studying math as a theoretical science. It is an interesting system to study today; it is highly visual and entirely geometric. We introduce a problem of possibility in converting areas between rounded and straight-edged shapes.

The first problem of this type is attributed to Hippocrates of Chios around 450BC. An influential mathematician who taught in Athens, Hippocrates wrote about math in a formal language that paved the way for later theoretical papers. As part of research to find the quadrature of a circle, (which was proven impossible using ruler and compass by Wantzel in the 1837AD,) he instead created a conversion of areas from specific triangles to lunes. A lune is any crescent-shaped portion of a plane or sphere bounded by two arcs of circles.



Given any isosceles right triangle ABC, we can construct two lunes with area equal to that of the triangle. First, bisect segment AB, the hypotenuse. Construct a semi-circle about the midpoint and call it O. By Thales' Theorem (624BC-546BC), we know that a circle with segment AB as its diameter will pass through point C as well, since ABC is right. Construct semi-circles on each X and Y, bisectors of AC and BC.

Though Hippocrates would not have calculated the area of these shapes as we do today, the Greeks used a ratio relating areas of circles to one another based on their area and diameter: the ratio of the area of one

(Continued)

circle to another is equal to the ratio of square on the diameter of one circle to the other. Thus (area of semicircle O) / (area of semicircle X) = $(AP^2) / (AC^2)$. Also, from the Pythagorean theorem, $AP^2 = AC^2 + CP^2 = 2AC^2$ since ABC is isosceles. Thus (area of semicircle O) / (area of semicircle X) = $2(AC^2) / (AC^2) = 2$. Therefore, semi-circle O is twice the size of semi-circle X, so semi-circle O is equal in size to semi circle X plus semi-circle Y. We subtract the overlap of these two sets of semi-circles, leaving us, instead of with semi-circles X and Y, with two lunes, and instead of with semi-circle O, with triangle ABC. Thus triangle ABC is equal in area to the two lunes surrounding points X and Y.

Pieces from Theses: A View from Susan Beckhardt ('08)

When it came time to decide what to do for my thesis and whom to work with, I had only one choice in mind: Professor Brenda Johnson. I loved the course in knot theory I had taken with her several years ago, and that summer I had had an opportunity to do some research with her as well. I got hooked on topology, especially knot theory, and Prof. Johnson was a great person to work with.

We decided that, since I had never had a topology course, I would teach myself point-set topology from the ground up. Topology is often jokingly described as "the branch of math that says a coffee cup is the same as a doughnut"; more generally, it is the study of sets (topological spaces) with a structure that is unchanged by continuous deformations--you can take a blob of rubber and bend, squeeze, or stretch it in any way you like, so long as you don't cut any part of it or glue together parts that were previously unattached. Distances between points are disregarded.

For those who have taken Real Variable Theory, the concept of continuous functions will be familiar, but topology generalizes the idea of continuity by defining it in terms of open sets. In fact, a topology on a set is defined by a collection of subsets (the open sets) satisfying several basic properties. From this and several techniques for constructing new topological spaces from existing ones, we can create such familiar topological objects as the torus, the Möbius strip, the Klein bottle, and the projective plane.

The structure of my learning process was different from any course I have ever taken. Professor Johnson gave me some very sparse notes, with nothing more than a set of definitions and the statements of theorems. On my own I proved each theorem, constructed examples, and discovered intuitive ways to describe the various techniques and concepts I covered. As a result of this self-driven way of learning, I feel I understand point-set topology more thoroughly than any other area of math I have studied.

With a solid understanding of the basic concepts of topology under my belt, it was time to tackle an interesting application--configuration spaces. Any time several objects can move around in a certain space, we can construct the space of all possible configurations of these objects. This can simplify the problem of finding safe paths for the objects to move in the space without collisions, among many other applications. Depending on the topology of the original space, and the number of objects in question, the configuration space can get extremely complex, but we can use tools provided by topology to determine the basic structure of the space as well as finding ways to simplify it.

I enjoyed my study of topology immensely, and it is one of several areas of math I intend to pursue in grad school at SUNY Albany. It's a rich field that intersects with nearly every other area of math: geometry, analysis, algebra, and even number theory! Overall, the thesis experience was rewarding and fun.

Problem of the Newsletter: May 23, 2008

Congratulations to **Schuyler Smith** for submitting a correct solution to last week's VOODOO problem. You can view a winning solution on the bulletin boards in Bailey Hall.

Here is this week's problem: Complete the additive alphametic by determining the correct digit for each letter:
ROOK + TO + KING + THREE = CHECK,
where KING is even and CHECK is odd.

Professor Friedman will accept solutions until 12:00 noon Thursday, May 29th.