Computation of Option Pricing Models
Programming Assignment 1

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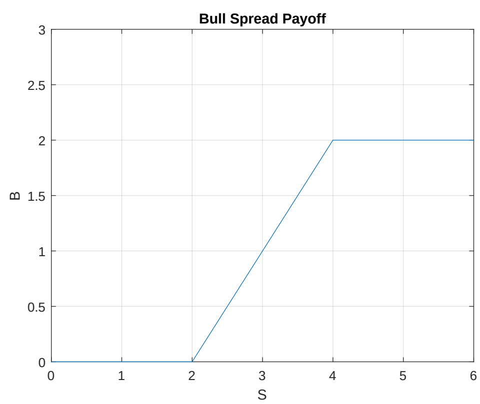
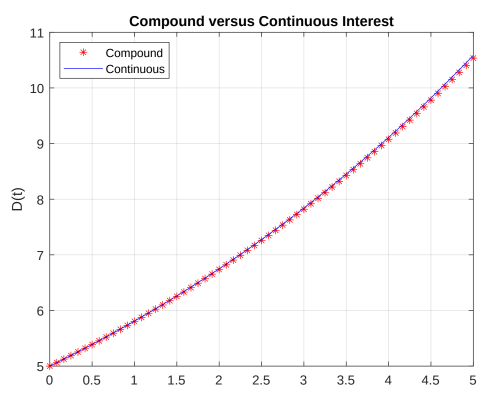
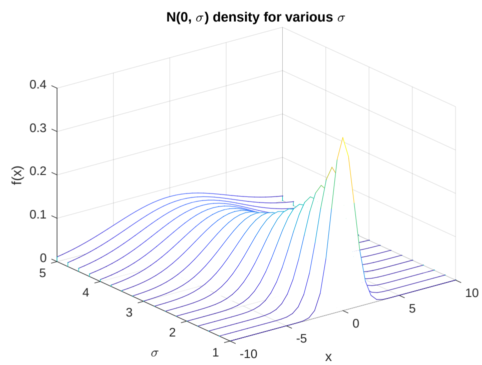
1. This script calculates and plots the payoff for two call options. It sets two strike prices (\$2 and \$4) and evaluates the result across a range of asset values from 0 to 6. The calculation subtracts the value of a call option at the higher price from one at the lower price, creating a graph that starts at zero, rises linearly between the two thresholds, and then caps at a fixed maximum value.



2. This script compares the growth of an investment using two different methods: monthly compound interest and continuous compound interest. It defines an initial value of 5 and an interest rate of 15% over a 5-year period. The calculation generates discrete data points for monthly compounding and overlays them with a smooth curve representing continuous compounding to visualize the relationship between the two growth models.



3. This script generates a 3D visualization of the normal distribution probability density function. It sets the mean to zero and evaluates the distribution across a grid where the standard deviation varies from 1 to 5. The calculation computes the density values for each combination, and the resulting waterfall plot illustrates how the bell curve flattens and spreads out as the standard deviation increases.



What follows is the MATLAB code for the exponential density function:

$$f(x) = \begin{cases} e^{-\lambda x} & x > 0, \\ 0 & x \leq 0. \end{cases}$$

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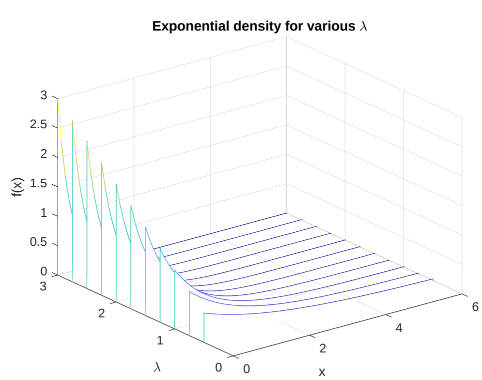
clf

dlambda = 0.25;
dx = 0.1;
[X, LAMBDA] = meshgrid(0:dx:6, 0.5:dlambda:3);

f(x) = lambda * e^(-lambda * x)
Z = LAMBDA .* exp(-LAMBDA .* X);

waterfall(X, LAMBDA, Z)
xlabel('x')
ylabel('\lambda')
zlabel('f(x)')
title('Exponential density for various \lambda')
```

And the associated plot.



4. This script illustrates the central limit theorem (CLT) using a Monte Carlo simulation. It performs $M = 10,000$ experiments, where each experiment calculates the standardized sum of $n = 500$ independent random variables drawn from a non-normal distribution. The code aggregates these standardized sums into vector S and plots a normalized histogram to represent the empirical probability density. Finally, it superimposes the theoretical standard normal density function, $\mathcal{N}(0, 1)$, as a red curve to visually demonstrate that the distribution of the sums converges to a normal distribution.