1. (a) Explain the concept of Net Present Value (NPV) using an example. How is it different from Internal Rate of Return (IRR)? (6.25)

(b) Ajay requires an amount of $129,200 by the end of seventeen years for which he wants to invest today. The money would earn 9 percent interest compounded annually and the deposits will be made in equal annual amounts. Every deposit is made at the end of each time period.

(i) What is the amount deposited by Ajay annually to achieve the objective? (3.25)
(ii) In place of making annual deposits, Ajay decides to make one single payment today to achieve the objective. What is the amount of this single payment if the money still earns 9 percent interest compounded annually. (3)

(c) Explain the annual worth method with the help of an example. How does it differ from the NPV analysis. (6.25)

1. अ) Net Present Value (NPV) की अवधारणा को उदाहरण सहित समझाइए। यह Internal Rate of Return (IRR) से कैसे भिन्न है?
b) Ajay wants to invest $129,200 today at 9% annual interest. He wants to receive all the money in 17 years. Therefore, he will make annual payments of $X$ at the end of each year for 17 years. This is a perpetuity with annual payments of $X$ at the end of each year, and an annual interest rate of 9%. He will make these payments at the end of each year for 17 years. Over these 17 years, the total amount he will receive is $X \times 17$. The present value of these payments is $PV = \frac{X \times 17}{1.09^{17}}$. Ajay wants to receive $129,200 today. Therefore, $129,200 = \frac{X \times 17}{1.09^{17}}$. Solving for $X$, we get $X = \frac{129,200 \times 1.09^{17}}{17}$.

(ii) Ajay wants to receive $129,200 today. He will make annual payments of $X$ at the end of each year for 17 years. Over these 17 years, the total amount he will receive is $X \times 17$. The present value of these payments is $PV = \frac{X \times 17}{1.09^{17}}$. Ajay wants to receive $129,200 today. Therefore, $129,200 = \frac{X \times 17}{1.09^{17}}$. Solving for $X$, we get $X = \frac{129,200 \times 1.09^{17}}{17}$.

(c) ANZ insurance company must indemnify a customer for a claim of $10 million in 1 year and of further $4 million in 5 years. The yield curve is flat at 10%. i. In order to completely fund and immunize the obligation using a single zero-coupon bond, what maturity bond must the insurance company purchase? ii. Derive the face value and market value of that zero-coupon bond?

2. (a) Find the Duration $D$ and Modified Duration $DM$ of a perpetuity that pays an amount $X$ at the end of each year. Assume a constant interest rate $r$ compounded yearly. (6.25)

(b) What are price-yield curves? Explain the property of price-yield curves with respect of maturity, coupon and yield to maturity. (6.25)

(c) ANZ insurance company must indemnify a customer for a claim of $10 million in 1 year and of further $4 million in 5 years. The yield curve is flat at 10%. i. In order to completely fund and immunize the obligation using a single zero-coupon bond, what maturity bond must the insurance company purchase? (3.25) ii. Derive the face value and market value of that zero-coupon bond? (3.25)
3. (a) Define Spot Rate and Forward Rate. Derive the relationship between the two. (6.25)

(b) How does expectations theory explain the terms structure of interest rate? (6.25)

(c) The current price of government treasury bonds is as follows:

<table>
<thead>
<tr>
<th>Maturity (in years)</th>
<th>Coupon</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0 percent</td>
<td>$97.474</td>
</tr>
<tr>
<td>2</td>
<td>5 percent</td>
<td>$99.593</td>
</tr>
</tbody>
</table>

Assuming all coupons are annually paid with each bond having a par value of $100. What are the 1-year and 2-year spot rates? What is the forward rate between year 1 and 2? (6.25)

3. (अ) स्पॉट रेट और फॉरवड रेट को परिभाषित करें। दोनों का सम्बन्ध निकालिये।
   (ब) अपेक्षा सिद्धांत ब्याज दर की शर्तों की व्याख्या कैसे करता है?
   (स) सरकारी ट्रेजरी बॉन्ड की वर्तमान कीमत निम्नानुसार है:

<table>
<thead>
<tr>
<th>Maturity (in years)</th>
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</tr>
</tbody>
</table>

माना कि सभी कूपन का भुगतान $100 के सम्मूल्य पर प्रत्येक बॉन्ड के साथ भुगतान किया जाता है। प्रथम वर्ष और द्वितीय वर्ष की स्पॉट दरें क्या होगी? वर्ष 1 और 2 के बीच आगे की दर (forward rate) क्या है?

4. (a) Variance of a portfolio is the weighted sum of variances of individual assets. True or False? Explain. (6.25)

(b) In a $\bar{r}$-$\sigma$ diagram defined by non-negative mix of two assets 1 and 2, prove that the triangular region defined by the two original assets, has a height on vertical axis $A = (\bar{r}_1\sigma_2 - \bar{r}_2\sigma_1)/\sigma_1+\sigma_2$. (6.25)

(c) The complete space of available risky securities comprises of a large number of stocks, each being identically distributed with $E(r) = 15\%$, $\sigma = 60\%$, and a common correlation coefficient of $\rho = 0.5$.
   (i) What are the expected return and standard deviation of an equally weighted risky portfolio of 25 stocks? (3.25)
   (ii) What is the smallest number of stocks necessary to generate an efficient portfolio with a standard deviation equal to or smaller than 43%? (3)
4. (a) Each portfolio's variance (variance) exhibits a tendency to be a sum of variances of all assets. Is this correct? Explain.

(b) Do portfolios 1 and 2 have a misalignment due to variance? Are they positively correlated in the vertical axis of the $\bar{r}-\sigma$ plane? Explain.

(c) The systematic risk (systematic risk) is a measure that cannot be diversified away. Why is it non-diversifiable? Explain.

5. (a) Differentiate between Capital Market Line and Security Market Line. (6.25)

(b) What is the beta of an efficient portfolio with $E(Rj) = 20\%$ if $Rf = 5\%$, $E(Rm) = 15\%$, and $\sigma m = 20\%$? What is its $\sigma j$? What is its correlation with the market? (6.25)

(c) What is systematic risk? Why is it non-diversifiable? (6.25)

5. (a) Proujji bajar rakh and prakriti bajar rakh are two different lines on the plane. Explain.

(b) If $Rf = 5\%$, $E(Rm) = 15\%$, and $\sigma m = 20\%$, then $E(Rj) = 20\%$ to be efficient? What is its $\sigma j$? What is its correlation with the market?

(c) Consider n securities, each having $E(Ri) = 0.01$, $\sigma^2(Ri) = 0.01$ and cov(Ri, Rj) = 0.005

(i) What is the expected return and variance of an equally weighted portfolio containing all n securities? (3.25)

(ii) What value will the variance approach as n gets larger? (3)

6. (a) Certainty equivalent formula brings linearity between prices of two assets. Explain. (6.25)

(b) “Inclusion of risk-free asset greatly simplifies the nature of feasible set”. Explain this statement in comparison to two-fund theorem. (6.25)

(c) Consider n securities, each having $E(Ri) = 0.01$, $\sigma_2(Ri) = 0.01$ and cov(Ri, Rj) = 0.005

(i) What is the expected return and variance of an equally weighted portfolio containing all n securities? (3.25)

(ii) What value will the variance approach as n gets larger? (3)
6. (अ) निश्चित समतुल्य सूत्र दो परिसंपत्तिों के मूल्यों के बीच रेखितकता लाता है। समझाइये।

(ब) "जोखिम मुक्त संपत्ति को शामिल करना संगत (feasible) सेट की प्रकृति को सरल करता है"। दो-कोष प्रमेय (two-fund theorem) की तुलना में इस कथन की व्याख्या कीजिए।

(स) n प्रतिभूतियों पर विचार कीजिए, जिनमें से प्रत्येक \( E(R_i) = 0.01, \sigma^2(R_i) = 0.01 \) और \( \text{cov}(R_i, R_j) = 0.005 \)

(i) सभी समान प्रतिभूतियों वाले एक समान भारित पोर्टफोलियो का अपेक्षित प्रतिफल और परिवर्तन क्या होगा?

(ii) n के बड़े होने पर विचारण का क्या मान होगा?