



FACULTY OF
BUSINESS AND ECONOMICS

ACST101
Techniques and Elements of Finance

Semester 1, 2011

Department of Applied Finance and Actuarial Studies

**MACQUARIE UNIVERSITY
FACULTY OF BUSINESS AND ECONOMICS
ACST101 UNIT GUIDE**

| | |
|---------------------------|----------------------------|
| Year and Semester: | Semester 1, 2011 |
| Unit convenor: | David Westcott |
| Prerequisites: | Nil (but see below) |
| Credit Points: | 3 |

HSC General Mathematics is assumed knowledge for BCom, BBA and other degrees offered by the Faculty of Business and Economics. If you have not studied mathematics at least equivalent to HSC General Mathematics you are advised to complete MATH123 Mathematics 123 before studying ACST101.

Students in this unit should read this unit guide carefully at the start of semester. It contains important information about the unit. If anything in it is unclear, please consult one of the teaching staff in the unit.

ABOUT THIS UNIT

Unit Description:

The principal components are the basic methods of financial calculations and the structure of the financial system. In this unit students analyse a range of financial instruments including investment accounts, promissory notes, mortgage loans, personal loans and bonds. They also learn about financial institutions (e.g. banks, insurance companies, superannuation funds), financial instruments (e.g. bills, bonds, shares) and financial markets.

Unit Rationale:

This unit provides an introduction to the pricing of financial instruments in the techniques section, and to the functions of the Australian financial system in the elements section. ACST101 is a prerequisite for further study in the areas of actuarial studies and finance. The unit also provides a practical introduction to finance for students not planning to continue with study in the area.

TEACHING STAFF

The staff members involved in the teaching and unit co-ordination of this unit are

| | | Room | Telephone | Email |
|----------------|-------------------|--------|-----------|--------------------------------|
| David Westcott | Unit Co-ordinator | E4A621 | 9850 8568 | Use Mail link on Blackboard |
| Gail Curry | Lecturer | | | |

For ALL email use the Mail link on the ACST101 Blackboard website. Click on Mail, then on Compose Message and select **ACST101 Inquiries** which is at the top of the Browse for Recipients list. Click on Save at the bottom of the page.

Questions relating to the administration of the unit should be directed to the Unit Co-ordinator. Questions relating to the unit content should be directed to your tutor at your tutorial or by email to ACST101 Inquiries.

CONSULTATION TIMES

Consultation times for the Unit Co-ordinator, lecturer and the tutors will be shown on the ACST101 Blackboard website under the Announcements link.

You are encouraged to seek help at a time that is convenient to you from a staff member teaching on this unit during their regular consultation hours. In special circumstances, an appointment may be made outside regular consultation hours. Staff will not conduct any consultations by email. You may, however, phone staff during their consultation hours.

Commencing in Week 3 there will be Peer Assisted Learning (PAL) workshops where students can learn in a group setting. The workshops will be led by students who have recently studied ACST101 and who have achieved very good grades.

Students experiencing significant difficulties with any topic in the unit must seek assistance immediately.

CLASSES

There are 3 hours of face-to-face teaching per week consisting of 2 x 1 hour lectures and 1 x 1 hour tutorial.

Class times can be found at: <http://www.timetables.mq.edu.au>

Lectures

The **Elements** lecture (Lecture 1) is held at the following time:

| | | | |
|-----------|-------------------|--------------------|---------------|
| Wednesday | 10 am in Mac. Th. | 12 pm in Price Th. | 3 pm in E7BT3 |
| Thursday | 3 pm in E7BT5 | 7 pm in X5BT1 | |

The **Techniques** lecture (Lecture 2) is held at the following time:

| | | | |
|-----------|-------------------|---------------|---------------|
| Wednesday | 1 pm in Price Th. | 4 pm in E7BT3 | |
| Thursday | 10 am in Mac. Th. | 4 pm in E7BT5 | 8 pm in X5BT1 |

You should attend your allocated techniques lecture and elements lecture each week.

The lecture notes for both techniques lectures and elements lectures are available from the ACST101 website. A copy should be brought to each lecture.

Tutorials

Tutorials which are held weekly commence in the second week of the semester.

Tutorial attendance is compulsory.

Students must attend and fully participate in at least **9** tutorials.

Tutorial enrolment or change of tutorial can be made through eStudent in the first two weeks of the semester. **No tutorial changes are allowed after Week 2.**

To prepare for each weekly tutorial, print a copy of the **Tutorial Exercises** from the website and attempt the first few questions eg for the Week 2 tutorial you should attempt Q1 to Q4 of the Tutorial Exercises on Week 1.

Check on eStudent for the **location of your tutorial**. Some tutorial rooms have recently been changed. **You must attend your allocated tutorial.**

RECOMMENDED TEXTS

The textbooks are available as a package from the Macquarie University Co-op Bookshop. They are also available in the Macquarie University Library.

Knox D M, Zima P and Brown R L, *Mathematics of Finance*, 2nd Edition, McGraw-Hill (1999)

Viney C, *Financial Market Essentials*, 1st Edition, McGraw-Hill (2011)

CALCULATORS

Calculators will be allowed in the class tests and the final examination but a clear indication of the steps involved in every calculation must be shown.

Non-programmable calculators with no text-retrieval capacity are allowed. Calculators that have a full alphabet on the keyboard are not allowed.

You will need a calculator which has x^y or x , $1/x$ and log or ln functions, and a memory.

UNIT WEB PAGE

Course material is available on BlackBoard.

The web page for this unit can be found at <http://learn.mq.edu.au>

The Student IT Service Desk (C5C244) provides information technology support and assistance to students of Macquarie University.

The login address gives you access to all of your online units. Just click on the name of the unit you want to work on. When you want to change from one unit to another click on My Online Units at the top right of the screen.

If you do not attend a lecture, you should consult the Announcements section of the website to see what information, if any, you have missed.

If you wish to contact the unit co-ordinator, use the ACST101 website. Click on Mail, then on Compose Message and send to ACST101 Inquiries.

The following are available on the website:

1. Lecture notes and Revision Exercises for "Techniques".
2. Lecture notes and internet exercises for "Elements".
3. Tutorial Exercises and solutions.
4. Assignments.
5. Class Test solutions for the past two semesters and the current semester.
6. Final Examination specimen exam papers and solutions.
7. Some videos revising techniques topics.

When moving around the website the path that you have followed is displayed below the ACST101 Techniques and Elements of Finance line. To move back to a previous page, click on the title of that page. In particular to move back to the opening page, click on Home Page.

An example is: Home Page > Tutorial Solutions > Tutorial Exercises on Week 1.

To close your connection click on Log out at the top right of the screen.

LEARNING OUTCOMES

Detailed learning outcomes are given in the lecture notes. The broad learning objectives of this unit are as follows.

1. Understand the concepts of present value and future value and apply to problems involving single payments.
2. Apply the concepts of present value and future value to problems involving annuities.
3. Use the concepts from 1. and 2. to price mortgage loans, bonds and debentures and other financial instruments.
4. Describe the functions of the Australian financial system and the financial institutions, financial instruments and financial markets which form part of it.

Understanding of the concepts is required rather than memorisation of formulae.

It is essential that you work steadily and consistently over the whole semester; in particular attend tutorials and keep up with the weekly assignments. You should revise the previous week's techniques lecture before you attend your weekly tutorial. Each topic builds on the previous one. **It is extremely difficult to catch up if you fall behind.**

The Academic Senate of the University has set the average workload as three hours total work per credit point per week. (ie 9 hours per week for ACST101). Total work includes time for private study and reading as well as attending classes and performing set tasks.

GRADUATE CAPABILITIES

In addition to the discipline-based learning objectives, all academic programs at Macquarie seek to develop the capabilities the University's graduates will need to develop to address the challenges, and to be effective, engaged participants in their world. This unit contributes to this by developing the following graduate capabilities:

1. Discipline Specific Knowledge and Skills
Have an appreciation of the time value of money
2. Critical, Analytical and Integrative Thinking
3. Problem Solving and Research Capability

TEACHING AND LEARNING STRATEGY

This unit is taught via lectures and tutorials. Tutorial exercises will be provided for each tutorial so that you can practise applying the results developed in lectures.

Weekly online assignments will encourage you to revise the material regularly.

The week-by-week list of the topics is as follows:

| Week Number | Week Beginning | Elements (Lecture 1) | Techniques (Lecture 2) | Class Test (Lecture 1) |
|-------------|----------------|-------------------------------------|-------------------------------------|------------------------|
| 1 | 21 February | Unit Overview | Simple interest & simple discount | - |
| 2 | 28 February | Elements Overview | Compound interest | - |
| 3 | 7 March | Banks, RBA, | Compound interest | - |
| 4 | 14 March | Bank Regulation | Annuities | - |
| 5 | 21 March | - | Annuities | 1 |
| 6 | 28 March | Non-bank institutions | Annuities | - |
| 7 | 4 April | Non-bank institutions | Mortgage loans | |
| STUDY | 11 April | STUDY | STUDY | |
| BREAK | 18 April | BREAK | BREAK | - |
| 8 | 25 April | - | Flat rate loans, NPV, IRR | 2 |
| 9 | 2 May | Government finances and instruments | Bonds & debentures | - |
| 10 | 9 May | Corporate finances and instruments | Tax on bonds | - |
| 11 | 16 May | Financial markets | Varying annuities | - |
| 12 | 23 May | - | Sinking funds and capitalised costs | 3 |
| 13 | 30 May | Revision | Revision | - |

In weeks where there is a Class Test there will be no Elements lecture.

RELATIONSHIP BETWEEN ASSESSMENT AND LEARNING OUTCOMES

The following table gives the relative weighting of the assessment components:

| | |
|-------------------------|-----|
| Weekly Assignments (11) | 10% |
| Class Tests (3) | 30% |
| Final Examination | 60% |

Assignments, Final Examination and Tutorial Attendance have minimum requirements.

Attendance

Tutorial attendance is compulsory.

Students must attend and fully participate in at least 9 tutorials.

Weekly Assignments

A satisfactory attempt by the due date is required for at least 8 assignments.

There are 11 weekly assignments, each mainly based upon a "techniques" topic. For each assignment you will use the website to obtain the questions and to enter your answers and obtain the full solutions.

Before you can access Assignment 1 due in Week 3 you must score 100% in the Unit Requirements Quiz **and** at least 80% in **both** the Maths Revision Exercises and the Practice Assignment. These preliminary quizzes are all due early in Week 2.

The marks for all 11 assignments are used to calculate the final assessment mark out of 10 based on assignments. **Assignments 7 to 11 are given double weighting.**

Details of the computerised assignments including the due dates are given separately.

The preliminary quizzes and Assignments 1 and 2 are used as early diagnostic tools to assess how well you are understanding the unit material and whether you need to revise basic mathematics or to reconsider your enrolment in the unit. Students requiring additional support should attend the consultation hours in the Numeracy Centre or join a PAL group.

Class Tests (held in Lecture 1 - Elements lecture time)

| | | | | |
|-------------------------|--------------------------------|------------------------------|-------------------------------|---------------|
| Test One (Week 5) | Wed. 23 March Thu. 24 March | 10 am Mac. Th. 3 pm E7BT5 | 12 pm Price Th. 7 pm X5BT1 | 3 pm E7BT3 |
| Test Two (Week 8) | Wed. 27 April Thu. 28 April | 10 am Mac. Th. 3 pm E7BT5 | 12 pm Price Th. 7 pm X5BT1 | 3 pm E7BT3 |
| Test Three (Week 12) | Wed. 25 May Thu 26 May | 10 am Mac. Th. 3 pm E7BT5 | 12 pm Price Th. 7 pm X5BT1 | 3 pm in E7BT3 |

The three Class Tests each count 10% of the final assessment.
Full details of the Class Tests will be given on the website under Announcements.
Students must attend at the lecture time for which they are enrolled.
The formula sheet will be displayed on the overhead projector.
Tests will be returned to students at the tutorial in the week following the test.
The procedure for requesting Special Consideration is detailed in a later section.

Class Tests will be based on the following lecture topics from page 5:

| | Techniques | Elements |
|--------|----------------|---------------|
| Test 1 | Weeks 1,2,3 | Weeks 2,3,4 |
| Test 2 | Weeks 4,5,6 | Weeks 4,6,7 |
| Test 3 | Weeks 7,8,9,10 | Weeks 9,10,11 |

Final Examination

To pass this unit a satisfactory performance is required in the final examination.

The final examination will contain questions from all techniques and all elements lectures. It will be a three-hour written paper with ten minutes reading time. The University examination period is between Mon. 6 June and Fri. 24 June 2011.

Part A: Forty-five multiple choice questions - twenty-two based on "techniques" and twenty-three based on "elements". Marked out of 45.

Part B: Three questions requiring application of "techniques" to the solution of practical problems. Marked out of 30.

The list of basic formulae shown at the end of this Unit Guide will be supplied.

The multiple choice questions are answered by marking (in pencil) a computer readable answer sheet. Bring TWO 2B Pencils, and an eraser, into the examination with you.

You are expected to present yourself for examination at the time and place designated in the University Examination Timetable. The timetable will be available in Draft form approximately eight weeks before the commencement of the examinations and in Final form approximately four weeks before the commencement of the examinations.

<http://www.timetables.mq.edu.au/exam>

The only exception to not sitting an examination at the designated time is because of documented illness or unavoidable disruption. In these circumstances you may wish to consider applying for Special Consideration. Information about unavoidable disruption and the special consideration process is given below.

If a Supplementary Examination is granted as a result of the Special Consideration process the examination will be scheduled after the conclusion of the official examination period.

You are advised that it is Macquarie University policy not to set early examinations for individuals or groups of students. All students are expected to ensure that they are available until the end of the teaching semester, that is the final day of the official examination period.

The Macquarie university examination policy details the principles and conduct of examinations at the University. The policy is available at:
<http://www.mq.edu.au/policy/docs/examination/policy.htm>

| | Assignments (11) | Class Tests (3) | Final Exam |
|------------------------------------|---|---|--|
| Description | Online quizzes | In-class test | Formal Exam |
| Due date | See schedule | See schedule | Exam period |
| % Weighting | 10% in total | 30% in total | 60% |
| Grading method | Mark out of 100. Marking system is given in quizzes | Mark out of 10. Marking system is given on test paper | Mark provided. Marking system is given on exam paper |
| Submission method | Online | In-class | Formal exam |
| Feedback | Worked solutions online within 1 day of the deadline for submission | Returned at the tutorial in the week following the test. Worked solutions made available online | None |
| Estimated student workload (hours) | 18 – 25 in total | 12 – 18 in total | 10 - 15 |
| Learning outcomes assessed | | | |
| 1 | ✓ | ✓ | ✓ |
| 2 | ✓ | ✓ | ✓ |
| 3 | ✓ | ✓ | ✓ |
| 4 | ✓ | ✓ | ✓ |
| Graduate capabilities assessed | | | |
| 1 | ✓ | ✓ | ✓ |
| 2 | ✓ | ✓ | ✓ |
| 3 | ✓ | ✓ | ✓ |

SPECIAL CONSIDERATION

The University is committed to equity and fairness in all aspects of its learning and teaching. In stating this commitment, the University recognises that there may be circumstances where a student is prevented by unavoidable disruption from performing in accordance with their ability. A special consideration policy exists to support students who experience serious and unavoidable disruption such that they do not reach their usual demonstrated performance level. The policy and procedure are available at:

http://www.mq.edu.au/policy/docs/special_consideration/policy.html

http://www.mq.edu.au/policy/docs/special_consideration/procedure.html

All requests for special consideration should be made in writing to the Student Enquiry Service and include full supporting documentation.

The Application Form and the Professional Authority Form which is required if you wish to request special consideration due to illness can be found at

<http://www.registrar.mq.edu.au/Forms/APSCons.pdf>

Requests for special consideration for a Class Test should be made within 5 days of the test. Also email ACST101 Inquiries indicating that you have submitted the form.

Requests for special consideration for the Final Examination should be made within 5 working days after the date of the examination or the day after the end of the examination period whichever is sooner.

Special Consideration will NOT be granted where a student has unsatisfactory class test marks, unsatisfactory assignment marks or unsatisfactory tutorial attendance. The exam content and/or assessment standards of supplementary examinations will be made more stringent to allow for the extra time available for prior study.

Further details about Special Consideration and Supplementary Examinations will be posted on the ACST101 website under Announcements in the last week of the semester.

ACADEMIC HONESTY

The nature of scholarly endeavour, dependent as it is on the work of others, binds all members of the University community to abide by the principles of academic honesty. Its fundamental principle is that all staff and students act with integrity in the creation, development, application and use of ideas and information. This means that:

- all academic work claimed as original is the work of the author making the claim
- all academic collaborations are acknowledged
- academic work is not falsified in any way
- when the ideas of others are used, these ideas are acknowledged appropriately.

Further information on the academic honesty can be found in the Macquarie University Academic Honesty Policy at http://www.mq.edu.au/policy/docs/academic_honesty/policy.html

GRADES

Macquarie University uses the grades HD (High Distinction), D (Distinction), Cr (Credit), P (Pass), and F (Fail) for grading the achievements of students in units of study. Grade descriptions and other information is in the Macquarie University Grading Policy which is available at: <http://www.mq.edu.au/policy/docs/grading/policy.html>

GRADING APPEALS AND FINAL EXAMINATION SCRIPT VIEWING

If, at the conclusion of the unit, you have performed below expectations, and are considering lodging an appeal of grade and/or viewing your final exam script please refer to the following website which provides information about these processes and the cut off dates in the first instance. Please read the instructions provided concerning what constitutes a valid grounds for appeal before appealing your grade.

http://www.businessandconomics.mq.edu.au/for/new_and_current_students/undergraduate/admin_central/grade_appeals.

STUDENT SUPPORT SERVICES

Macquarie University provides a range of Academic Student Support Services. Details of these services can be accessed at <http://www.student.mq.edu.au>

BESS E4B106 (The Faculty of **B**usiness and **E**conomics **S**tudent **S**ervices)
http://businessandconomics.mq.edu.au/for/new_and_current_students/undergraduate

Details of the times for Peer Assisted Learning (PAL) can be obtained from the BESS link.

Numeracy Centre C5A225

Students who lack the knowledge of mathematics needed for ACST101 are encouraged to seek the help of the Centre. Consultations are free of charge. Staff will recommend work to fill gaps in background knowledge of mathematics.

IT CONDITIONS OF USE

Access to all student computing facilities within the Faculty of Business and Economics is restricted to authorised coursework for approved units. Student ID cards must be displayed in the locations provided at all times.

Students are expected to act responsibly when utilising University IT facilities. The following regulations apply to the use of computing facilities and online services:

- Accessing inappropriate web sites or downloading inappropriate material is not permitted. Material that is not related to coursework for approved unit is deemed inappropriate.
- Downloading copyright material without permission from the copyright owner is illegal, and strictly prohibited. Students detected undertaking such activities will face disciplinary action, which may result in criminal proceedings.

Non-compliance with these conditions may result in disciplinary action without further notice.

Students must use their Macquarie University email addresses to communicate with staff as it is University policy that the University issued email account is used for official University communication.

TECHNIQUES TOPICS AND TEXTBOOK REFERENCES

Textbook

Knox D M, Zima P and Brown R L, *Mathematics of Finance*, 2nd edition, McGraw-Hill (1999). The answers to the even-numbered exercises start on page 297, the answers to the odd-numbered exercises can be found on the website on the Tutorial Exercises page.

| Week | Techniques Topic | Textbook Reference |
|------|--|--|
| 1 | Simple Interest and Simple Discount | Chapter 1 (exclude 1.4 and 1.5) |
| 2 | Compound Interest | Chapter 2, 2.1 to 2.3 (exclude 2.4) |
| 3 | Compound Interest, Logarithms and Linear Interpolation | Chapter 2, 2.5 to 2.8 Appendices A & C |
| 4 | Valuation of Annuities | Chapter 3, 3.1 to 3.3 Chapter 4, Section 4.2 |
| 5 | Valuation of Annuities | Chapter 3, 3.4 to 3.7 Chapter 4, 4.3 and 4.5 |
| 6 | Valuation of Annuities | Chapter 4, Section 4.4 Chapter 5 (exclude 5.4) |
| 7 | Mortgage Loans | Chapter 6, 6.1 to 6.4 |
| 8 | Flat Rate Loans Net Present Value and Internal Rate of Return | Chapter 6, Section 6.6 (exclude Rule of 78) Chapter 8, 8.1 and 8.2 |
| 9 | Bonds and Debentures | Chapter 7, 7.1 to 7.4 |
| 10 | Tax on Bonds | Chapter 7, 7.5 and 7.7 (exclude section 7.6 and pages 207 - 211) |
| 11 | Varying Annuities (The approach taken will be different to that of the textbook) | Chapter 4, Section 4.6 |
| 12 | Sinking Funds and Capitalised Costs | Sections 6.5, 7.8 and 8.3 |

Notes

- 1 Other sections of the textbook not referred to above are outside the scope of this unit and are NOT examinable.
- 2 The "Part A" exercises in the textbook are ideal for practice in applying the "techniques" to solve financial problems. Some "Part B" exercises which involve mathematical proofs are beyond the scope of this unit.

ELEMENTS TOPICS AND TEXTBOOK REFERENCES

Textbook

Viney C, *Financial Market Essentials*, 1st Edition, McGraw-Hill (2011)

References

Crane R, Fraser I and Martin T, *Financial Institutions, Markets and Instruments*, 5th edition, LBC Information Services (2001)

Valentine T, Ford G and Copp R, *Financial Markets and Institutions in Australia*, Prentice Hall (2003)

Hunt B and Terry C, *Financial Institutions and Markets*, 4th edition, Thomson (2005)

In addition the *Reserve Bank of Australia Bulletin* contains articles of current interest and statistical information. The "elements" tutorial exercises will contain a link to the RBA website which contains much of this information.

Topics and Recommended Reading from Textbook

Topic 1 Overview of the Financial System

Week 2 Chapter 1

Topic 2 Banks and RBA

Week 3 Chapter 2 (2.3), Chapter 3 (3.1 to 3.4)

Week 4 Chapter 3 (3.5 to 3.6)

Topic 3 Non-Bank Institutions

Week 6 Chapter 4 (4.4 to 4.6, 4.9)

Week 7 Chapter 3 (3.7), Chapter 4 (4.2 to 4.3, 4.7 to 4.8), Chapter 5 (5.7 to 5.8)

Topic 4 Government Finances and Instruments

Week 9 Chapter 10

Topic 5 Corporate Finances and Instruments

Week 10 Chapter 6 (6.2 to 6.6, 6.8), Chapter 7 (page 229)

Topic 6 Derivatives

Week 11 Chapter 11 (11.3 to 11.5)

ERRATA TO KNOX, ZIMA & BROWN, *Mathematics of Finance*, 2nd edition

| | | |
|----------|--------------------|--|
| Page 7 | Example 2 | Answer should be \$8.91 not \$6.51 |
| Page 10 | Example 4 | The bill was purchased on 2 May not 3 May |
| Page 52 | Solution Example 2 | In the line beginning <i>Step 1</i> , 1000 should be 10000 |
| Page 64 | Example 2 | The interest rate is $j_4 = 12\%$ not $j_4 = 3\%$ |
| Page 227 | Formula for i | Numerator should be $F_0 + F_1 + F_2 + F_3 + \dots + F_n$ |
| Page 297 | Exercise 1.6 Q4 | Answer should be \$1025.28 not \$810.66 |
| Page 299 | Exercise 3.6 A Q2 | Answer should be \$4291.72 not \$2262.56 |
| Page 300 | Exercise 6.5 A Q2 | Answer should be sinking fund by \$302.25 not \$1090.80 |

ACST101 : Techniques and Elements of Finance

FORMULAE FOR USE IN EXAMINATIONS

- 1 Future value at simple interest

$$S = P(1 + rt)$$

- 2 Present value at simple interest

$$P = S(1 + rt)^{-1}$$

- 3 Present value at simple discount

$$P = S(1 - dt)$$

- 4 Future value at compound interest

$$S = P(1 + i)^n$$

- 5 Present value at compound interest

$$P = S(1 + i)^{-n}$$

- 6 Future value of n payments of R at compound rate i

$$S = Rs \frac{i}{n} = R \left[\frac{(1 + i)^n - 1}{i} \right]$$

- 7 Present value of n payments of R at compound rate i

$$P = Ra \frac{i}{n} = R \left[\frac{1 - (1 + i)^{-n}}{i} \right]$$

- 8 Approximation to bond or debenture yield for given price

$$i \approx \frac{I + \frac{1}{n}(C - P)}{\frac{1}{2}(C + P)}$$

- 9 Present value of an annuity with payments increasing in arithmetic progression

$$P = R[(1 + i)^{-1} + 2(1 + i)^{-2} + \dots + n(1 + i)^{-n}]$$

$$= R \left[\frac{(1 + i)a \frac{i}{n} - n(1 + i)^{-n}}{i} \right]$$

- 10 Future value of an annuity with payments increasing in arithmetic progression

$$S = R \left[\frac{(1 + i)s \frac{i}{n} - n}{i} \right]$$

- 11 Present value of an annuity with payments increasing in geometric progression

$$P = R[(1 + i)^{-1} + (1 + r)(1 + i)^{-2} + \dots + (1 + r)^{n-1}(1 + i)^{-n}]$$

$$= R(1 + r)^{-1} a \frac{j}{n} \text{ where } j = \frac{i - r}{1 + r}$$

- 12 Future value of an annuity with payments increasing in geometric progression

$$S = R(1 + r)^{n-1} s \frac{j}{n} \text{ where } j = \frac{i - r}{1 + r}$$