



University of Technology, Sydney

**Faculty of Engineering and Information
Technology**



Subject

Database Programming (31253)

**Assignment 2
Autumn 2012**

Assignment Title

Forecasting Electricity Demand

Due date - 18:00 31st May 2012
Hand in to Laurie before the lecture starts



INSTRUCTIONS

1. This is an individual assignment and is worth 30% of your final grade. The Assignment will require a commitment of about 25 hours and addresses objectives 1, 2, 3, 4 and 5 as outlined in the Subject Outline.
2. For ease of marking, I would like you to document your approach to the solution of the problem. Please keep your description short, relevant and to the point. It is strongly recommended that you utilize diagrams to convey your ideas. Your description will help me understand your code better. Please indicate any features that you are particularly proud of or that you want to be noted during the marking process.
3. You are expected to submit a professional presentation in a soft copy format on a CD, prepared using a suitable Word Processor. A hand written submission is not acceptable and will not be marked.
4. I will be looking at your code and data in the Database, so please DO NOT include any code in your submission.
5. Please include your ORACLE userid on the front page of your submission where the marker can easily find it. DO NOT INCLUDE YOUR PASSWORD
Also please provide your email address so the marking sheet can be sent to you.
6. There may be errors and ambiguities in the assignment specification. If so, corrections/clarifications will be posted to the subject site on UTSONLine. You are expected to regularly check the site and incorporate any changes into your submission. The specification will be frozen two weeks before the due date.
7. Please take note of the due date, and work to that date, as extensions without penalty will be granted only under exceptional circumstances. Students should be aware that a penalty will be applied for late submissions.
Penalty is as follows
 - + Up to one week late incurs a 20% penalty.
 - + Up to two weeks late incurs a 40% penalty.
 - + Assignments which are more than two weeks late will not be accepted.
8. I expect to return the marked assignments no later than 14 days after the submission date. Since I will not see you to hand back the Assignment and the marking sheet please include your email address on your submission so that I can email the marks to you.
I will send you a comment sheet which will include the breakdown of marks and my observations noted while running/markings your code.
9. Students are advised to make themselves familiar with the Academic Misconduct statement detailed in the Student Guide and conduct themselves according to the expectations of the University.
10. It has been noted that due to lack of industry experience, many students find it difficult to understand some of the Assignment requirements. To aid in understanding I will utilize UTSONLine extensively to convey ideas and to clarify any misunderstandings. As part of this subject you will be expected to check the postings on UTSONLine regularly.



Table of Contents

INSTRUCTIONS	2
Document History	3
Glossary of Terms	4
Overview	5
Information to help Understanding	6
Distribution regions in NSW	6
Diagrammatic Representation of Power Distribution	7
Database specifics.....	8
NEM_RM16 table	8
DBP_HOLIDAY.....	8
MESSAGE Logging	8
Additional Objects.....	9
Database Diagram	10
Specification of the RM16 report	11
Your Task.....	11
Deliverables.....	12
Marking Scheme	14

Document History

15-APR-2012	Initial



Glossary of Terms

BASIC METER	A meter that measures electricity flow as a continuous value. A Speedo is an example of a Basic meter. Consumption is calculated by subtracting one value from another.
INTERVAL METER	A meter that measures electricity consumption as a continuous flow but records the meter value each half hour interval.
TNI	Terminal Node Identifier. It is a logical grouping of distribution terminating points from the generator to the delivery point. Physically, TNI's comprise of many metering points from many different generators
FRMP	Financially Responsible Market Participant. This is the retailer who is responsible for the purchase and the resale of electricity. The purchase is from AEMO and the sale is to the customer base in the TNI.
LR	Local Retailer. This is the Market Participant that is responsible for the Transmission and delivery of the electricity to a region. When the electricity market was government controlled an LR was allocated to maintain electricity supplies to a region
STATEMENT TYPE	AEMO produces RM16 statements at regular intervals. The full volume of the electricity consumption may not be known at the time that the statement is produced. Statement type then denotes the status of the report. The values are PRELIM, REVONE, REVTWO, FINAL
RM16	Is a statement issued by AEMO each week. The statement is issued to each market participant and shows only their consumption for a TNI in a given day. The consumption volumes are provided at half hour intervals.
Market Participant	The electricity market is made up of a number of generators and retailers. The market can be looked at as a pool where the generators add to the pool (sell) and the retailers buy from the pool to service their customers. AEMO is the controller of the pool and all settlements are done with AEMO. The individual organizations, whether generators or retailers are the Market Participants.
MDP	Meter Data Provider. The code of the organization that reads the meter
CHANGE_DATE	The field is updated every time any change is performed on the record
AEMO	Australian Energy Market Operator



Overview

There is considerable activity in the electricity industry at the moment with the NSW Government well on a path to privatizing the retail electricity industry. NSW will join Victoria, South Australia, Queensland and Tasmania to become part of the deregulated Electricity market.

As a result, electricity retailers will be canvassing existing customers to sign up with them and have their electricity supplied by them. The reality of course is that the customers' electricity will still be produced by the same generators and delivered to the customers' home by the same distribution network. What will change though is who will be responsible to ensure that the correct volume of electricity is produced to satisfy demand and who will be the billing agent that the clients will pay their electricity bills to.

In order to make the electricity market function, all the retailers and generators participate in what is known as an *Electricity Market*.

The market is a pool where the producers bid to supply and the retailers bid to buy from to supply their customers. This pool is managed and controlled by a government authority called AEMO. The buying and selling of the electricity is done by electricity traders working for the various Energy companies like Energy Australia, Origin, Alinta, TRUEnergy and many others.

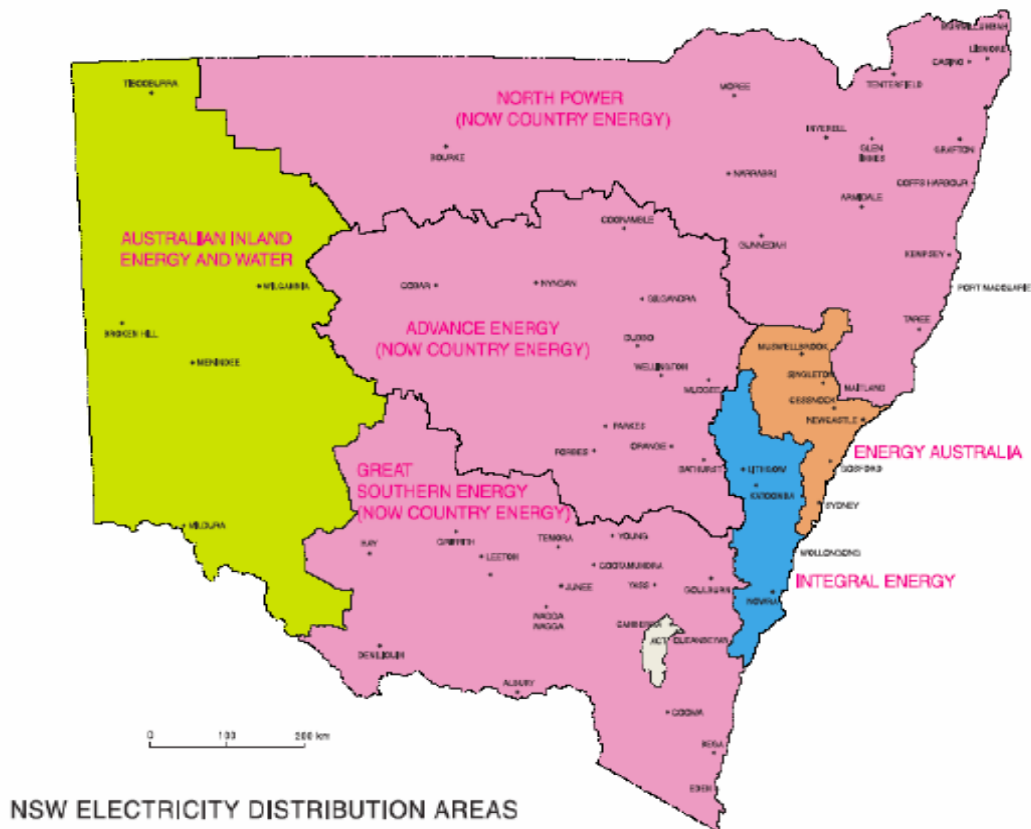
The bidding process by the sellers and buyers is what determines the electricity price and this price is set at 5 minute intervals. AEMO aggregates the 5 minute prices into half hour intervals and publishes these prices continually.

The electricity traders need to be able to determine as accurately as possible what will be the total consumption for their consumers is in order to be able to purchase the right amount of energy and capitalize on market fluctuations at each one of the half hour intervals.

AEMO produces a historical consumption report at regular intervals and provides the consumption data for each of the participants in the market. Each participant report is for the total volume of that participant only, broken down by LR and FRMP regions. This report is known as a RM16 report and is produced and distributed weekly.

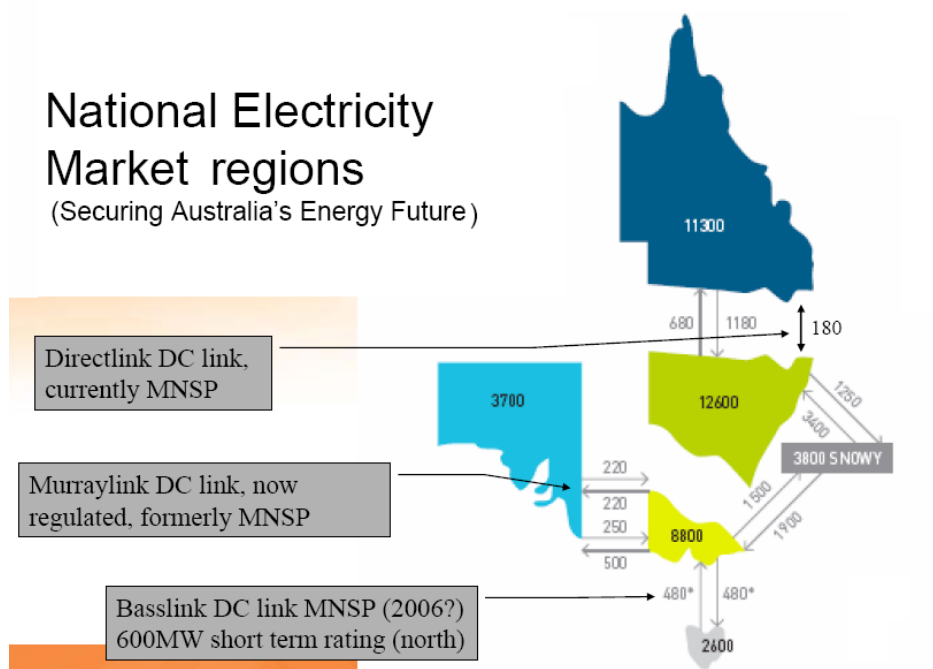
Information to help Understanding

Distribution regions in NSW



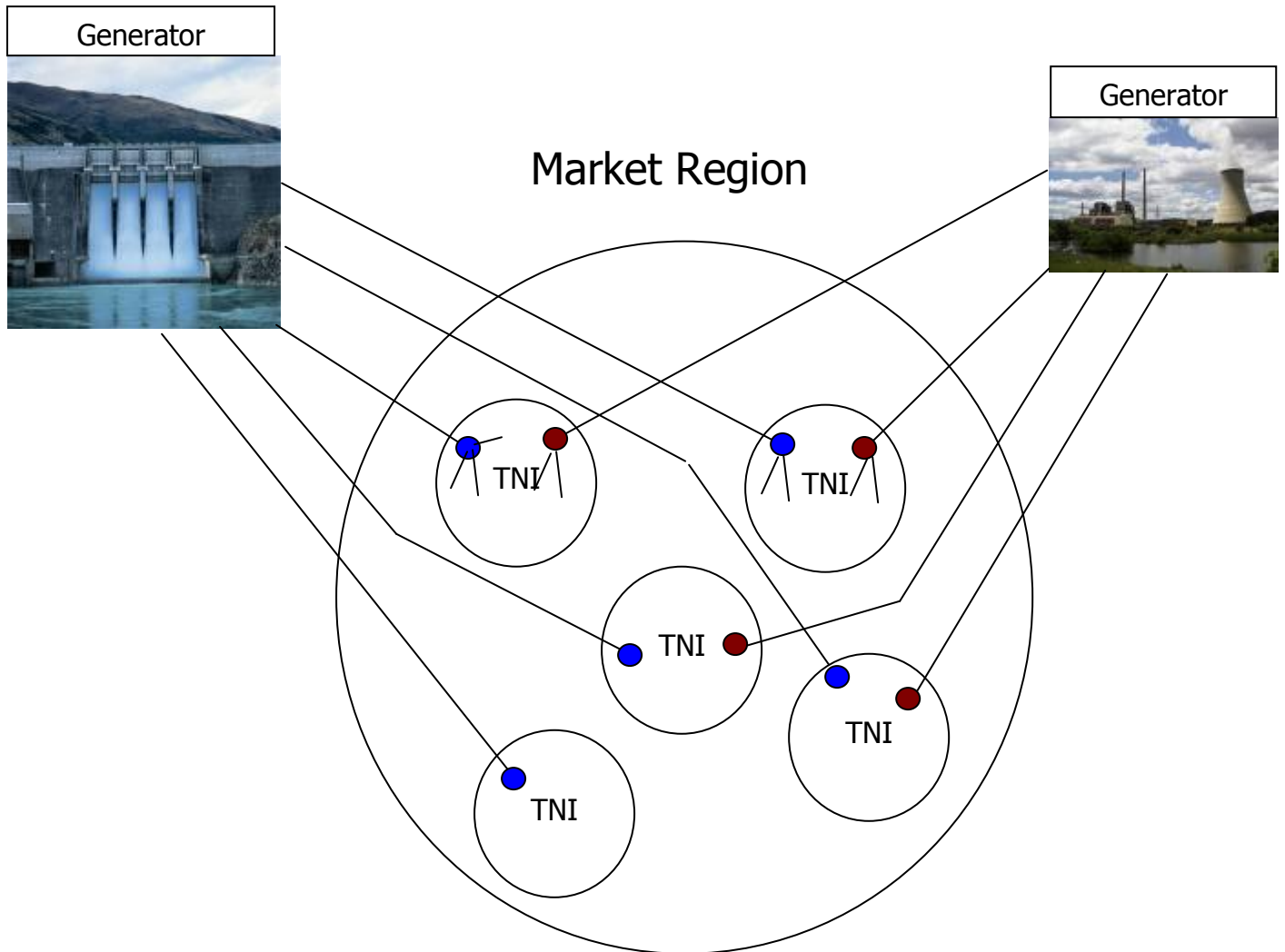
The map of NSW shows how the state is divided into distribution boundaries

National Electricity Market regions (Securing Australia's Energy Future)



Diagrammatic Representation of Power Distribution

Showing how many generators provide power to one TNI



Electricity is distributed using high voltage cables from the various generators that are located throughout the states.

Each market region has many terminating points where the electricity flow is metered, stepped down in voltage and then distributed to the consumers.



Database specifics

NEM_RM16 table

The RM16 data from AEMO is delivered into a table called NEM_RM16. The NEM_RM16 has an object as an attribute. The object is called VALUE_HH. The VALUE_HH object is a nested table object of type RM16_DAY which in turn is an array of 48 objects RM16_HH which is a record of two elements HH and VOLUME. This object is used to represent the 48 daily half hour elements and their associated consumption volume.

The script to create the objects and the RM16 tables will be made available on UTSONline

You will create your own LOCAL_RM16 table to store your calculated FORECAST values. Your table will be a direct copy of either my table with the object or my view with the object unwrapped into individual attributes

If you chose to go with the object then the details on how to work with the object will be provided in class and on UTSONline.

The basic select statement is

```
SELECT r.* , v.*  
FROM NEM_RM16 r, TABLE(VALUE_HH) v
```

DBP_HOLIDAY

This table has the list of days that are deemed holidays. If a date appears in this table then it is to be treated as a holiday

MESSAGE Logging

Your program should log its progress into a log table. This table is called DBP_MESSAGE_LOG. You do not have direct access to insert into this table, rather a procedure has been developed to enable you to log your messages.

The procedure is called COMMON.LOG.

How to log

In your code issue the following statement

```
COMMON.LOG(<your message>)
```

```
Eg COMMON.LOG('Before updating the LOCAL_RM16 table');
```

To view your message

```
SELECT *  
FROM DBP_MESSAGE_LOG  
WHERE USERID = <your user id>  
ORDER BY MSG_DATE desc;
```




Additional Objects

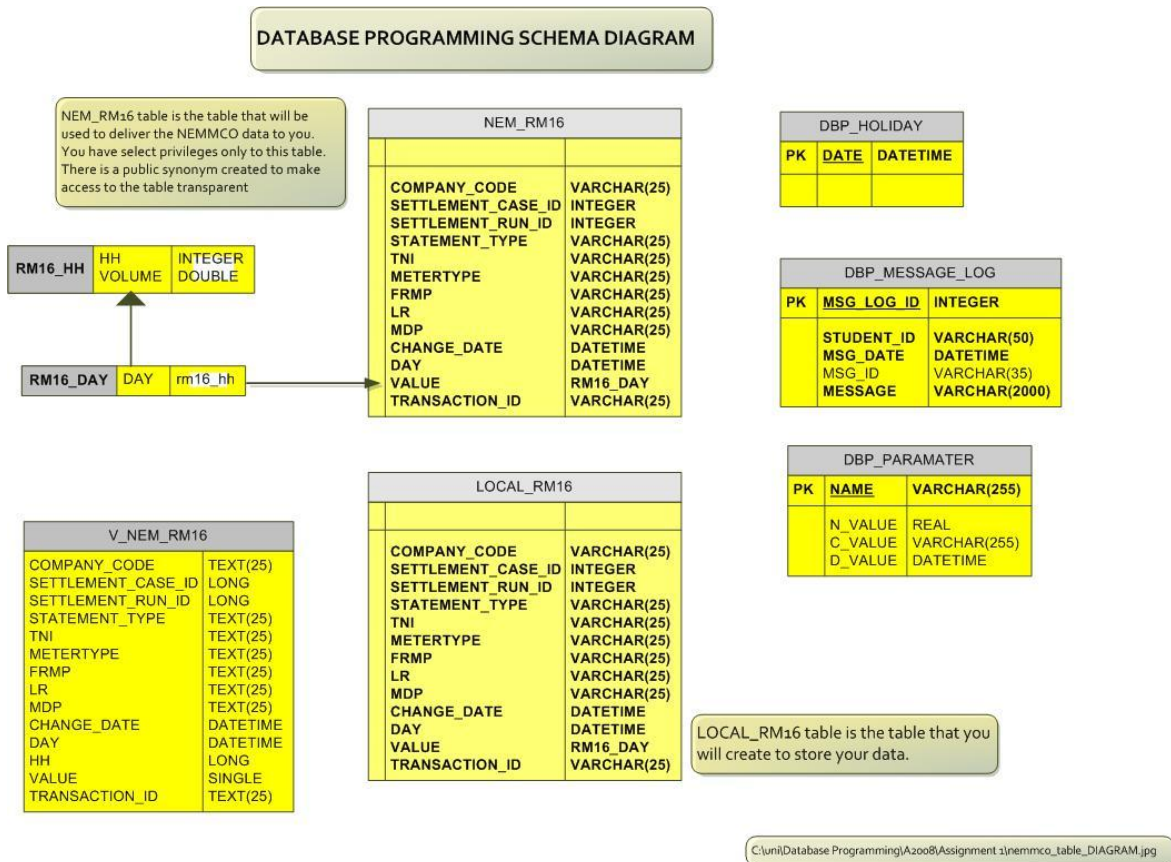
It is unlikely that you will require additional tables, however if you feel that your solution will be enhanced by additional tables, views or any other object then you are free to create as many additional objects as you like.

But please be aware – Do not create any tables in your schema that are a copy of my tables and data.

During marking I will be manipulating data in my schema to check how your program behaves. If you copy tables and data into your schema and write your program to access your data instead of mine then the changes I make during run time will not be reflected in your program run. Your program will then not work correctly and this will be reflected in your mark.



Database Diagram



The view v_NEM_RM16 is created with the query

```
CREATE OR REPLACE FORCE VIEW dbp_admin.v_nem_rm16 (company_code,
                                                    settlement case id,
                                                    settlement run id,
                                                    statement_type,
                                                    tni,
                                                    metertype,
                                                    frmp,
                                                    lr,
                                                    mdp,
                                                    change_date,
                                                    DAY,
                                                    transaction_id,
                                                    hh,
                                                    volume
                                                    )
AS
SELECT r.company_code, r.settlement_case_id, r.settlement_run_id,
       r.statement_type, r.tni, r.metertype, r.frmp, r.lr, r.mdp,
       r.change_date, r.DAY, r.transaction_id, v."HH", v."VOLUME"
FROM nem_rm16 r, TABLE (r.value_hh) v;
```



Specification of the RM16 report

The RM16 report is broken down as follows

- Each state is broken into a number of Distribution areas referred to as Patches.
- Each patch is divided into a number of TNI's (Terminal Node Identifiers). These are the logical divisions where the very high voltage cables from the generators terminate and the flow of power is metered. There will be a number of termination points in each TNI.
- For every TNI there is a Local Retailer (LR) and a FRMP (Financially Responsible Market Participant)
- The consumption data is provided for each day and broken down into half hour intervals.
- Statement type – AEMO produces data at regular intervals but due to various reasons not all the data is available at publishing time. AEMO still releases the data but depending on its completeness marks the data with a STATEMENT_TYPE. The statement type is like a version control which describes the quality of the information provided. The values are PRELIM, REVONE, REVTWO and FINAL.
- Meter type is the classification of the meter. Ie BASIC, INTERVAL etc (See the glossary of Terms for meter definition). The meter type has no impact on your task

Your Task

The electricity traders are required to bid into the market daily for the amount of electricity that is to be purchased to satisfy the customer demand. As the traders bid into the market, AEMO will instruct a generator to produce that amount of electricity. This means that the trader (on behalf of the retailer) will have to pay for the generated energy, whether it is used or not. Likewise heavy penalties are imposed on retailers if they do not balance their consumption with the generated volume.

For that reason, the estimation of the volume of energy to be consumed is critical to the profitability of the organization. In order to minimize the risk to the organization, your task is to

- Forecast the energy requirements for each TNI, LR, FRMP combination, daily at each half hour interval.
- Your forecast should be calculated for two weeks into the future.
- The forecast should be for each TNI, LR, FRMP at each of the 48 half hour intervals
- Each forecast record that you create should have the STATEMENT_TYPE marked as FORECAST



- The forecast half hour values for each day in the future should be based on the average of the half hour values for the previous same day and half hour combination ie Sundays should be forecast as an average of only the Sundays in the past, Mondays should only be the average of the Mondays in the past etc.
- Holidays are a special case. If you are forecasting for a day in the future that is a holiday then you must only average out the consumption of the previous holidays. If there is no past holiday consumption data then use the past Sundays consumption data for the future holiday forecast. Do not mix the two, either use Sundays consumption or holiday consumption. The day type is immaterial for Public Holidays.
- When forecasting for future days that are not holidays you must not use days in the past that are holidays to determine the average consumption.
- You must consider only actual consumption values to determine the average consumption. Ie STATEMENT_TYPE is not equal to 'FORECAST'
- Update the CHANGE_DATE column to system date for any records created or updated

The following file and email options are not mandatory. They are worth 15% of the mark so if you do not do these then your maximum mark will be 85%

- Produce an XML file written to the Operating System that lists the total consumption for each TNI for a date after the run date (sysdate + 1)
Output details will be provided
- Provide a facility to email the xml file as an attachment to the email message. The file should be emailed to *<nominated email address>*

Deliverables

Note I will be looking for a professional presentation produced by professionals.

In your submission you are expected to deliver

- Description of the Task
- Technical Design of your Solution
- A working version of your solution. It is not acceptable to provide code that will not run.



- Code, a soft copy stored in your schema in the database. I will be running your program in the database. I will also be marking the code that is in the database so DO NOT provide a hard copy of your code in your submission.

Note:

The Assignment code is to be written in a package. The package should be named **Assignment2**. To allow me to automate the marking process, you should name your entry module **RM16_forecast**. You should also honor the table names that I have given you. Any additional object that you create can be at your discretion, but I will be looking for the documentation in your Technical Spec.

You are free to create other packages but remember that the purpose of a package is to Amalgamate like code. But if you are creating a package for something like library functionality then it may be appropriate to create a new package.

This is the code I will use to automate the run of your package.

```
BEGIN  
Assignment2.RM16_forecast;  
END;
```



Marking Scheme

Total weight of Assignment 30%

Design of the Problem Solution	15
Compiles Correctly and is easy to run	5
Code Modularization	5
Appropriate commenting and documentation	5
Variable Naming (self documenting)	10
Appropriate exception handling	10
Is the code tight and concise	15
Is the code easily maintainable	5
Run against the full data, how did the code perform	10
Professional Presentation	5
File and email option implemented	15

Design

Can I understand how the solution is implemented by reading the design document.

Presentation

Diagrams, Language, Font, Graphics, Index Page, Headings etc
Does it look good?

Modularization

Has the code been split into procedures and function
ie broken down to manageable modules.

Maintainable

Are values repeated? *Eg Date format DD-MON-YYYY*
Does the same code repeat throughout the solution?