Faculty of Engineering and Technology

Department of Computer Science

Coursework Title: Data Modelling Scenario

Module Name: Data Modelling
Module Code: 4104COMP
Level: FHEQ 4
Credit Rating: 10

Weighting: 100%
Maximum mark available: 100

Lecturer: Dr Mark Evans
Contact: If you have any issues with this coursework you may contact your lecturer. Contact details are:
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Room: BS/607c

Hand-out Date: 25th February 2021

Hand-in Date: 16th April 2021 by 17:00
Hand-in Method: Online via Canvas

Feedback Date: 6th May 2021
Feedback Method: Email

Programmes: CF, CGD, CSci, CSec, CS, MMC, SE, DS, CN

Introduction

This is an ***individual*** piece of work. You are not allowed to work with anyone else during the completion of this assignment.

You must submit your work via the *Assignment Handler* in Canvas on or before the due date/time.

You are given the following business scenario and set of requirements and are required to 1) construct a spreadsheet-based application from these requirements, 2) derive a set of relational schemas and construct entity relationship models and 3) translate these models into a database application. You are then required to produce a report that describes and demonstrates each of these tasks.

Learning Outcomes to be assessed

1. Construct a spreadsheet-based application from a given set of requirements.
2. Create a logical and physical entity relationship model from a given set of requirements.
3. Construct a database-based application from a logical and physical entity relationship model.

Details of the task

The management of "The Printers", a large local printing company, need to report on various aspects of their system, using both spreadsheets and databases. Your task involves implementing a spreadsheet application, modelling their internal recruitment records system and implementing that as a database. You are then required to produce a professional report that details these activities.

Part 1

Firstly, you are asked to produce a spreadsheet that models the company's sales for it's leaflet, poster and flyer production division over a period of 5 years. The company is well established and provides leaflet, poster and flyer printing in multiples of 1000 sheets for customers in all paper sizes from A0 to A7, and in paper thicknesses (also known as 'weights') that range from the maximum of 250g/m^2 to the minimum of 70g/m^2. The division prints in one colour (usually black) and they refer to this as 'Monochrome', however, a full colour printing service is available to its customers as a paid for option.

All orders have a 'Base Price'. The 'Base Price' is determined by charging the customer; for the number of sheets printed, for the size and thickness (weight) of the paper selected and then applying the charge for 'Monochrome' print.

If the customer requires 'Monochrome' print, then the calculation of the 'Base Price' is equal to the 'Total Sales (ex.VAT)' value. If the customer requires 'Colour' print, the 'Monochrome' calculation (for the 'Base Price') is still done, but then an additional value is added to that to cover the charge for the selected 'Colour' print option. As such, the 'Monochrome' price + the 'Colour' print charge = Total Sales (ex. VAT), when 'Colour' print is specified by the customer. The division offers an option to its customers to have their print work folded in one of two types (single folded or double folded) with each option increasing the price of the customer's print order (hence the 'Total Sales (ex. VAT)) accordingly.

The company does not accept orders for print of any type where the ordered quantity is below 1000 and it also does not accept orders that are not in whole multiples of 1000. The division operates a printing machine and this is an asset that is depreciated. This depreciation is recorded in their system as an expense and is deducted from their monthly sales alongside the other additional monthly expenses to compute monthly Net Profit. The value of the depreciation expense is fixed for each month in any given year, but the fixed amount charged per month changes year by year. The sales of various volumes of paper of particular sizes and thicknesses (weights) are provided for each trading month from January 2016 to December 2020, together with an indication of whether print was in 'Monochrome' or in 'Colour'. The sales volumes sold per month also indicate what type of folding had been applied. The monthly expenses have been provided alongside the corresponding depreciation value for that month also.

Using the ***Coursework1_part1.xlsx*** document, complete this spreadsheet so that sales and net profit/loss over the course of 5 years can be tracked and reported. The spreadsheet will need to include the following functionality:

1. Based on the requirements, and using appropriate Excel functionality to locate specific values within specific cells, use suitable formulas to reference the content of the 'Pricing Matrix' to obtain the 'Price per 1000 sheets' for each of the 'Paper Size' and 'Paper Weight' values in each row of the spreadsheet (row 13 to row 492)

2. In column H, determine the 'Base Price' for the customer order that is based upon the quantity that they have ordered (per Column E) and the value you have obtained from (1) above.
    a. *If Column F contains 'Colour' calculate 'Charge for Colour Output (£)' for each Row and display that value in Column I*.
    b. *If Column G contains either 'Double' or 'Single' calculate the corresponding 'Charge for Folding (£) value for each Row and display that in Column J.*
    c. *Calculate the 'Total Sales (ex. VAT) (£)' value for each Row and display that in Column K.*
    d. *Calculate the 'Total Expenses (£)' value for each Row and display that in Column N.*
    e. *Calculate the 'Net Profit/Loss (£) value for each Row and display that in Column O (Net Profit/Loss is the Total Sales Value (ex.VAT) (£) after deducting monthly expenditures)*
    f. *Cumulative profit/loss*: ***defined as the amount you are left with after combining the previous month's cumulative profit/loss with the current month's sales (monthly income) and then deducting your monthly expenditures.***

3. Starting from when trading began, using appropriate formulas/functions, calculate the following statistics and display the results in columns J, L and M (rows 2,3,4 and 5) respectively:
    a. Sales Grand Total (2016-2020) (£)
    b. Maximum Sale (2016-2020) (£)
    c. Minimum Sale (2016-2020) (£)
    d. Average Sale (2016-2020) (£)
    e. Expenses Grand Total (2016-2020) (£)
    f. Maximum Expense (2016-2020) (£)
    g. Minimum Expense (2016-2020) (£)
    h. Average Expense (2016-2020) (£)
    i. Net Profit / Loss Grand Total (2016-2020) (£)
    j. Maximum Net Profit (2016-2020) (£)
    k. Maximum Loss (2016-2020) (£)
    l. Average Net Profit / Loss (2016-2020) (£)

4. Apply Conditional Formatting to the *Net Profit/Net Loss (£) column* columns to satisfy the following condition:
    a. Instances that depict a loss should be red.

5. The entire spreadsheet should also be suitably formatted to depict the correct units. All numeric values must be rounded to zero decimal places and any monetary values must be formatted using the 'Accounting' numerical formatting (with zero decimal places).

6. **BONUS MARKS:** Using Pivot Charts / Tables, determine the quantity sold per year (2016 – 2020) of each paper size (A0 to A7) and produce a Stacked Bar Chart detailing your findings. The graph must be correctly formatted with a Title, Axis labels and a suitable legend. The pivot table that accompanies your chart must be conditionally formatted in a suitably informative manner and both the pivot table and the pivot chart must be presented just below the horizontal (purple) line per row 496 of your coursework submission.

Part 2

Secondly, the managers at national head office need to plan their internal staff recruitment by recording aspects related to when current staff members apply for different jobs within the same company. You can assume that:

- Applicants for Jobs can apply for zero, one or more Jobs.
- If an Applicant's application proves successful, they will be invited to attend an Interview.
- Each Applicant currently works in one department only and, if they are successful at interview and get the job, they would only work in one department only.
- Each interview that is attended by an Applicant is also attended by one member of Management.
- If any other staff attend an interview with the Manager, the group of staff attending represents an Interview Panel.
- Each Interview Panel must have one Manager.
- A given advertised Job will receive many applications.
- A given job may require an Applicant to attend more than one interview.
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Your task includes:

1. Using the information and raw sample data in Appendix A, and the un-normalised relational schema (ONF) in Appendix B, derive a set of relational schemas that are (where appropriate) in 3NF. State any assumptions/justifications for the design decisions that you make.
2. Using all of your normalised data from 2.1), produce a *Conceptual Entity Relationship Diagram* (ERD), using Crow's Foot Notation, which illustrates appropriate entities and relationships.
3. Using your conceptual ERD from 2.2), produce a *Logical ERD*, using Crow's Foot Notation, which illustrates appropriate entities, attributes, relationships and primary/foreign keys.
4. Using your logical ERD from 2.3, transform this diagram into a *Physical ERD*, using Crow's Foot Notation, which specifies appropriate table names, column names, relationships, primary/foreign keys, data types, length and nullability.
5. Using your physical ERD from 2.4 as the basis for your implementation, implement the database for the Personnel system using Microsoft Access. The database should be populated with the raw sample data from Appendix A.

Your report should be suitably formatted/presented, structured logically and be free from grammar and spelling errors. To prepare your report, you are advised to use a word processor (such as *Microsoft Word* or *OpenOffice/LibreOffice*) that supports spelling and grammar checking.

What you should hand in

You should submit a single ZIP file containing 1) your word-processed report (Microsoft Word or Adobe PDF formats only), 2) your completed Excel spreadsheet and 3) your completed Access database file to the Assignment Handler in Canvas.

No other forms of submission are allowed without prior written permission from the module leader.

Marking Scheme/Assessment Criteria

Assessment	Assessment Criteria	% weighting for criteria
Report	***Part 1***	
	Calculations/Formulas	20%
	Graphs (Bonus Marks)	5%
	Conditional Formatting	5%
	Spreadsheet Presentation	5%
	Part 2	
	Normalisation	10%
	Conceptual Entity Relationship Diagram	10%
	Logical Entity Relationship Diagram	10%
	Physical Entity Relationship Diagram	10%
	Database Implementation	20%
	Structure, writing style and presentation of report	5%

Guidelines:

- Correctly reference any resources that you use.
- You must specify any assumptions you make as you make them and include them and any general comments, along with your answers.

Resources Required:

You may use the computing labs on the 6th & 7th floors of the Byrom Street Campus, as well as the 1st floor of the Henry Cotton Campus.

You should make use of these specific tools & resources:

- Microsoft Office (Excel, Word, Visio and Access).
- Lecture Materials.
- The Internet.

Extenuating Circumstances

If something serious happens that means that you will not be able to complete this assignment, you need to contact the module leader as soon as possible. There are a number of things that can be done to help, such as extensions, waivers and alternative assessments, but we can only arrange this if you tell us. To ensure that the system is not abused, you will need to provide some evidence of the problem.

Any coursework submitted late without the prior agreement of the module leader will receive 0 marks.

Academic Misconduct

The University defines Academic Misconduct as 'any case of deliberate, premeditated cheating, collusion, plagiarism or falsification of information, in an attempt to deceive and gain an unfair advantage

in assessment'. This includes attempting to gain marks as part of a team without making a contribution. The Faculty takes Academic Misconduct very seriously and any suspected cases will be investigated through the University's standard policy:

(https://www.ljmu.ac.uk/about-us/public-information/student-regulations/appeals-and-complaints).

If you are found guilty, you may be expelled from the University with no award.

It is the responsibility of the student to ensure that you understand what constitutes Academic Misconduct and to ensure that you do not break the rules. If you are unclear about what is required, please ask.

It is also the responsibility of the student to take reasonable precautions to guard against unauthorised access by others to his/her work, however stored in whatever format, both before and after assessment.

For more information you are directed to following the University web pages:

- Information regarding ***academic misconduct***:
- https://www.ljmu.ac.uk/about-us/public-information/student-regulations/academic-misconduct

- Information on ***study skills***:
- https://www.ljmu.ac.uk/microsites/library/skills-ljmu/academic-study-skills
- https://www.ljmu.ac.uk/students/supporting-your-study

- Information regarding ***referencing***:
- https://www.ljmu.ac.uk/microsites/library/skills-ljmu/referencing-and-endnote

- Information regarding the ***Academic Framework*****:** https://www.ljmu.ac.uk/about-us/public-information/academic-quality-and-regulations/academic-framework

Appendix A – Normalised relational schema (Raw Data):

MANAGEMENT

Member Number	**Member First Name**	**Member Surname**	**Telephone Number**	**Last Sat on Panel**	**Department Number**
9001	John	Stevens	99-1210	01/02/2014	4
9002	Harry	Davidson	99-3499	02/03/2015	4
9003	Wendy	Gilbody	99-7865	10/03/2015	4
9004	Peter	Fong	99-6754	03/05/2016	2
9005	Jenny	Fu	99-2367	29/09/2016	4
9006	Basil	Davis	99-8932	03/11/2016	4
9007	Hiram	Peters	99-1155	29/11/2016	2
9008	Diana	Marshall	99-8787	29/11/2016	2
9009	Sally	Limbani	99-3487	31/12/2016	3
9010	Derek	Lyndhurst	99-5577	01/04/2018	1
9011	Jane	Harris	99-8788	31/08/2018	1
9012	David	Smith	99-4421	01/10/2019	1
9013	Sarah	Stevens	99-3231	04/07/2020	3
9014	Everton	Rogers	99-2128	29/11/2020	3

Department Numbers:

1 = Software Development

2 = Engineering

3 = Commercial

4 = Finance

INTERVIEW PANEL

PANEL NUMBER	**MEMBER NUMBER**
1	9001
2	9002
3	9003
4	9004
5	9005
6	9006
7	9007
8	9008
9	9009
10	9010
11	9011
12	9012
13	9013
14	9014

INTERVIEW

INTERVIEW NUMBER	**JOB NUMBER**	**APPLICANT ID**	**INTERVIEW DATE**
1	1145	3221	01/02/2014
2	3077	3221	02/03/2015
3	3097	3221	10/03/2015
4	3312	3222	03/05/2016
5	4000	3221	29/09/2016
6	4123	3221	03/11/2016
7	4412	3323	29/11/2016
8	4413	3222	29/11/2016
9	4435	3324	31/12/2016
10	5021	3323	01/04/2018
11	5098	3222	31/08/2018
12	6074	3222	01/10/2019
13	7046	3323	04/07/2020
14	7809	3324	29/11/2020

Appendix B – Un-normalised relational schema (0NF):

Attribute Name	Sample Value	Sample Value	Sample Value	Sample Value
APPLICANT ID	3323	3222	3324	3221
APPLICANT FIRST NAME	Stan	Jenny	Max	Daisy
APPLICANT SURNAME	Lee	Jones	Smith	Edwards
APPLICANT ADDRESS	1 The Crescent	5 The Avenue	10 The Street	8 The Road
APPLICANT CITY	Liverpool	London	Birmingham	Manchester
APPLICANT POSTCODE	L15 2RT	N7 4AB	B1 1TY	M1 3GH
APPLICANT PHONE NUMBER	11-111	22-222	33-333	44-444
APPLICANT EMAIL	leestan@test.com	jj@test.com	max@test.com	daisy@test.com
APPLICANT PRESENT POSITION	Programmer	Technician	Analyst	Financial Controller
APPLICANT PRESENT DEPARTMENT	Software Development	Engineering	Commercial	Finance
JOB ID	4412 5021 7046	3312 4412 5098 6074	4435 7809	1145 3077 3097 4000 4123
JOB START DATE	01/12/2016 03/04/2018 06/07/2020	05/05/2016 01/12/2016 02/09/2018 03/10/2019	02/01/2017 01/12/2020	03/02/2014 04/03/2015 12/03/2015 01/10/2016 05/11/2016
JOB TITLE	Technician Programmer Analyst	Clerk Technician Junior Programmer Programmer	Analyst Senior Analyst	Junior Clerk Accounts Assistant Accountant Financial Controller Finance Director
JOB STARTING SALARY	£25,000 £45,000 £75,000	£15,000 £25,000 £35,000 £45,000	£75,000 £105,000	£12,000 £22,000 £45,000 £65,000 £120,000
JOB DEPARTMENT	Engineering Software Development Commercial	Engineering Engineering Software Development Software Development	Commercial Commercial	Finance Finance Finance Finance Finance

APPLICANT (**APPLICANT ID**, APPLICANT FIRST NAME, APPLICANT SURNAME, APPLICANT ADDRESS, APPLICANT CITY, APPLICANT POSTCODE, APPLICANT PHONE NUMBER, APPLICANT EMAIL, APPLICANT PRESENT POSITION, APPLICANT PRESENT DEPARTMENT {JOB ID, JOB TITLE, JOB START DATE, JOB START SALARY, DEPARTMENT NUMBER, JOB DEPARTMENT, PRESENT POSITION, PRESENT DEPARTMENT })