204KM Operational Research

Module Guide 2016/2017

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Module Name	Operational Research
Module Number	204KM
Module Tutors	Dr Rochelle Sassman (module leader) Dr Magesh Nagarajan, Dr Kamal Bentahar, Dr Jianbing Ma
Phone	07557425391 (Before 6pm please)
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Module Size	20 credits
Study Hours	200
Deliverable items	Report 1 – Survey (worth 20%) Report 2 – Linear Programming (worth 20%) Exam (worth 60%) Coursework must be at least 35% and Exam must be at least 35% and module mark must be at least 40%.

MOODLE SUPPORT

Moodle Online contents	yes
Provide lecture notes	yes
Results/marks	Yes
Moodle discussion	Yes
Other	no

TEACHING SESSIONS

Lectures:	Thursdays at 2pm in ECG.26
Seminars:	Mondays at 11am in EC1.01, Thursdays at 9am in EC1.01

ASSESSMENT DATES

1. 24/02/2017 – Report 1 : Survey
2. 31/03/2017 – Report 2: Linear Programming

Module Summary

This module adopts a practical approach to data management and operational research. It introduces techniques and/or methods for identifying data sources, for searching efficiently, and for the collection, classification, representation, interpretation and analysis of data retrieved. Some techniques and applications associated with a broad range of areas of OR are covered. The module aims to provide students with an insight into both the use of the techniques and some of the underpinning theory.

The methods taught are used extensively in many industries and local and national government, and also research and development. In addition this module develops useful skills which can be used in some final year projects.

LEARNING OUTCOMES

On completion of this module a student should be able to:

1. Explain and apply various methods of data collection for diverse uses. Design, conduct, analyse, report and critically evaluate a small-scale sample survey.
2. Model a range of situations for analysis by OR methods. Solve a range of business decision problems using appropriate software, analyse the output, and interpret the results in context.
3. Explain the basic ideas behind a range of OR techniques and summarise their underlying assumptions, applications and limitations.

LECTURES

Content covered in lectures include:

Data
Definitions; the use of data in business; standards; data quality. Identification of sources, relevance and access, e.g. government statistics, financial and business statistics. The Internet and other methods as appropriate.

Practical Primary Data Collection and Analysis
Experiments and surveys, questionnaire design, sampling strategies. tools and techniques; analysis of data from a small scale survey and effective communication of the findings.

Linear Programming
History and nature of OR investigations, Linear programming: formulation, use of computer software (e.g. LINDO), basic Simplex algorithm, duality, sensitivity analysis, Transportation algorithm, applications such as scheduling and data envelopment analysis.

Operational Research applications, such as:
Inventory control models, deterministic inventory control models, including Economic order quantity

Assessments and marking criteria (overleaf)

204KM Operational Research

Assignment 1 – Design and Analysis of a Survey

Lecturer's name	Dr Rochelle Sassman
Coursework Title or Number	Design and Analysis of a Survey
Module Number	204KM
Required Submission Date	23:55 on 24 February 2017
Intended Coursework Return Date	10 March 2017
Learning Outcomes Covered	1
Marking Scheme and Marking Criteria	Included
Percentage of Module Mark	40%
Estimated Effort (hours/words)	40 hours Report - Maximum 2000 Words.
Submission Details	Submit : Report (pdf or docx file) via Turnitin on 204KM Moodle Site.
Feedback Mechanism	Scripts marked online with individual Comments In class discussion.

‘A Small Scale Sample Survey’
Assignment 1

The University is keen to know what the student’s feel about the service that is provided to them., The University would like to Design a small scale survey which will investigate an aspect of student life at Coventry University. Examples of which could be:

- Teaching styles and approaches
- Levels and quality of the course work offered.
- Teaching facilities
- Attitude to e-learning and flipped classroom
- Feedback offered by the staff on your course
- Student enrolment and the first few weeks
- Industrial placements
- Catering services
- Sporting facilities
- Student’s image of Coventry University
- The extend that the course prepares you for the “real world”
- Teaching as a career
- Provision by the University for students with a disability
- The University use of social media in teaching

You may decide to select something which is not on the above list or even adapt one of the suggestions. Discuss your idea with the lecturer before commencing.

You are required to write a report which includes the following:

1. **Aims and objectives of your survey.**
   The aims should outline what the main goals of your survey are and the objectives should show how you will meet those aims.

2. **Discussion, in the context of your survey, the sampling strategy and also the sample size.** *Put the survey in context. Explain why you selected a specific sampling strategy over others. Example the sampling size based on the population.*

3. **A questionnaire in line with the aims and objectives of your survey.**
   Include a blank copy of your questionnaire in the appendix.

4. **An explanation of the design of your questionnaire.**
   This should cover but is not restricted to explaining why you asked certain questions, the types of questions included, the layout and font used, how you removed bias in the questionnaire, good features of the questionnaire etc.

5. **Analysis and presentation of your findings in the form of appropriate charts & discussion. Use clear quantitative statements when describing your charts.**
   When carrying this analysis ensure you consider what your aims and objectives are and the questions you included in the questionnaire. Try and create a narrative rather than go through the questions in your questionnaire one at a time. Think about the use of pivot tables and charts to compare across multiple features.

6. **A conclusion to your report.**
   This should outline the main findings of the study supported by quantitative statements, consider what the aims of the survey were and provide recommendations where appropriate.

7. **A brief critical evaluation of the overall process which you have gone through in designing and analysing your survey.**
   This should outline how you could have carried out the survey in a better way, what you learned and any problems you overcame.

Please note that:

- The survey is to contain a maximum of 10 questions.
- Data is to be collected from up to 30 students.
- The report should be a maximum of 6 sides, plus appendix.
- The font should be Times New Roman, the Font Size 12 pt and the line space Single
- You must not email students the questionnaire.
- You must include a copy of the participation leaflet & ethics form in your appendix.

For a threshold pass of 40% a student will typically design a simple questionnaire to collect relevant information, from a sensibly chosen sample. The student will analyse the data and present the findings in a brief report.

For a mark of 70% plus a student will typically have demonstrated careful thought in the design of his/her questionnaire and planning of the survey, with the emphasis on collecting good data that will enable him/her to achieve the stated aims. A well constructed, professional, report will demonstrate a competent analysis of the data, using appropriate charts and tables communicating their findings clearly

MARKING SCHEME

Introduction, aims and objectives of your survey.	/10
Discussion, in the context of your survey, the sampling strategy and also the sample size.	/5
A questionnaire in line with the aims and objectives of your survey. Include a blank copy of your questionnaire in the appendix.	/10
An explanation of the design of your questionnaire.	/5
Analysis and presentation of your findings in the form of appropriate charts and discussion. Use clear quantitative statements when describing your charts.	/10
A conclusion to your report.	/5
A brief critical evaluation of the overall process which you have gone through in designing and analysing your survey.	/5
A participation leaflet and ethics from in your appendix.	/10
	/60

SUBMISSION DETAILS

The module is using an on-line submission/marking scheme. Electronic submission of the coursework report will be via the turnitin link in the 204KM Moodle site .

Your report submission should be in word (*.doc or *.docx) format or pdf format.

The maximum word count for the report is 2000 words, but this limit is to the report and not the appendix of the report.

204KM Assignment Rubric (/60)

Criteria (/60)	F Below 40%	D 40-49%	C 50-59%	B 60-69%	A Above 70%
Introduction (includes context, research problem statement, aim(s) & objectives) (/10)	Primarily a list of facts, both relevant and irrelevant. Lacks coverage of key areas. Little connections between facts. Research aims & objectives are unclear and/or irrelevant.	Presents relevant and irrelevant facts. Some key areas of analysis missing. Some evidence of connections between the facts. Research aims & objectives are not entirely clear and sometimes irrelevant.	Presents mostly relevant facts, covers most of the important areas. Good integration of facts. Research aims & objectives are mostly clear and generally relevant.	Thorough and insightful, and includes mostly relevant facts. Very good demonstration of integration. Research aims & objectives are clear, relevant, and specify desired end states.	Remarkably thorough and insightful. Only relevant facts are superbly integrated to present a comprehensive overview of situation. Research aims & objectives are entirely clear, extremely relevant, and clearly specify desired end states.
Sampling strategy (/5)	Methodology described with minimal detail and justification for sampling strategy is weak.	Methodology described with some detail and sampling strategy is only partially justified.	Most of methodology described in good detail, and justification for sampling strategy is good.	Accurate detail provided for majority of methodology and sampling strategy is well justified.	Methodology described in extensive and accurate detail and sampling strategy is extremely well justified.
Questionnaire Design (/15)	The reader cannot identify a line of reasoning and loses interest. Questionnaire does not meet criteria defined; lacks insight, thoughtfulness, and creativity.	The reader is fairly clear about what writer intends. Only partially meets criteria defined; shows some insight, thoughtfulness, and creativity.	For the most part, the reader can follow the line of reasoning. Meets the criteria defined; demonstrates good insight, thoughtfulness, and creativity.	The reader can follow the line of reasoning. Does a very good job of meeting the criteria defined; demonstrates very good insight, thoughtfulness, and creativity.	It sustains interest throughout. Meets the criteria defined very well; is exceptionally insightful, thoughtful, and creative.
Findings and Discussion (/10)	Analysis is often inaccurate, lacks insight, and/or is described in insufficient detail.	Analysis is partially accurate, demonstrates limited insight, and/or described in minimal detail.	Analysis is mostly accurate, demonstrates some insight, and/or described in adequate detail.	Analysis is mostly accurate, quite insightful, and/or thoroughly described.	Analysis is entirely accurate, demonstrates exceptional insight and understanding, and/or is described in excellent detail.
Conclusions (/5)	Conclusions described with minimal detail. Disconnected from objectives, and research findings.	Conclusions described with some detail. Loosely connected to objectives, and research findings.	Most of the conclusions described in good detail. Partially connected to objectives, and research findings.	Very good detail provided for majority of conclusions. Well connected to objectives, and research findings.	Each conclusion element described in extensive detail. Extremely well connected to objectives, and research findings.
Critical Evaluation (/5)	Evaluation lacks insight, thoughtfulness, and creativity.	Evaluation shows some insight, thoughtfulness, and creativity.	Evaluation demonstrates good insight, thoughtfulness, and creativity.	Evaluation demonstrates very good insight, thoughtfulness, and creativity.	Evaluation is exceptionally insightful, thoughtful, and creative.

204KM OPERATIONAL RESEARCH

COURSEWORK 2

Lecturer's name	Dr Magesh Nagarajan
Coursework Title or Number	Coursework 2
Module Number	204KM
Required Submission Date	23:55 on 31 March 2017
Intended Coursework Return Date	15 April 2017
Learning Outcomes Covered	2 and 3
Marking Criteria	Included
Percentage of Module Mark	20%
Estimated Effort (hours/words)	20 hours
Report	Maximum 1 000 Words.
Submission Details	Submit : 1. Report (pdf) 2. Excel worksheet (.xls) Submission via 204KM in the Moodle website.
Feedback Mechanism	Scripts marked online with individual Comments and in class discussion.

Intended Learning Outcomes of 204KM Operational Research

1. Explain and apply various methods of data collection for diverse uses. Design, conduct, analyse, report and critically evaluate a small-scale sample survey.
2. Model a range of situations for analysis by OR methods. Solve a range of business decision problems using appropriate software, analyse the output, and interpret the results in context.
3. Explain the basic ideas behind a range of OR techniques and summarise their underlying assumptions, applications and limitations.

FLIGHT CAPACITY SCHEDULING PROBLEM

"Takk Fyrir" (Thank you in Icelandic) said Judy Scully to a smiling crew member on receiving special diet meal during her first pleasure trip to Iceland. She is flying out to the most common airport in Iceland i.e. Keflavik (KEF) in proximity to Reykjavik, the capital.

Iceland has attracted about 1.2 million passengers in the calendar year 2015-16 (Source: Statistics Iceland). UK tourists remain one of the top nationals who visit Iceland. Among the EU countries Germany and France respectively follow UK as prominent European tourists. Datasheet-1 presents the monthly number of passengers visited Iceland on various months in the year 2015 (Source: Statistics Iceland).

Iceland Air, the national carrier of Iceland is reorganising its regional operations considering the existing demand profile and planning for new routes. Predominantly Iceland Air's fleets are Boeing 757-200 with a capacity of 250 seats. In this problem, there are three origins considered for schedule planning (namely UK, France and Germany) with one prominent airport in each namely, London Heathrow (LHR), Paris (CDG) and Frankfurt (FKR). Currently there are three classes of bookings, namely

- economy flight only (Class A),
- economy flight with four days accommodation (Class B) and
- Business class with four days accommodation (Class C).

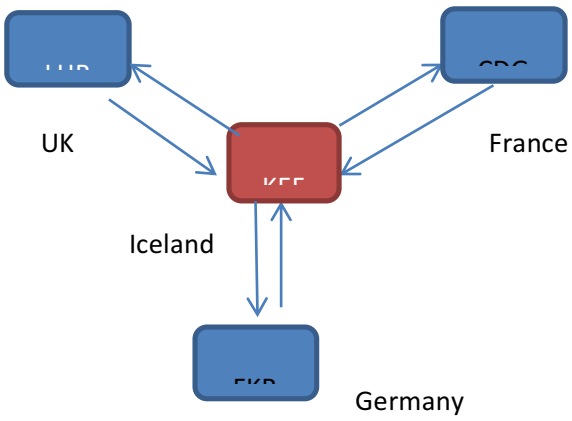

Figure 1 Regional route for scheduling flight capacity

Mark Neumann, the strategic planner (Europe Operations) for Iceland Air has been given the task of deciding how many flights to allocate in each route in a profitable manner. As a consultant you have been asked to support his decision using Operational research model.

TASK-1:

1. Using Datasheet 1, estimate the annual demand from UK, France and Germany.
2. If all these tourists were assumed to be flying from one airport in respective countries, what would be the weekly average number of passengers **in the peak month**?

(10 marks)

Table 1 Number of seats per week in each of the routes (to be completed)

Route	Number of seats per week
LHR-KEF	
CDG-KEF	
FKR-KEF	

TASK-2:

Based on historical sales data, it was found that number of bookings in each of three classes was not the same for each origin airport. The proportion of classes (%) in the three routes are presented in Table 2. Typical ticket price (in £) for each class during the peak month is given in Table 3.

Table 2. Percent of seats for various classes in the three routes

Ticket Class	LHR-KEF	CDG-KEF	FKR-KEF
A	47	47	45
B	28	26	28
C	25	27	27

Table 3. Number of seats booked in each class along the three routes

Ticket Class	LHR-KEF	CDG-KEF	FKR-KEF
A	380	450	560
B	600	670	880
C	1170	1300	1550

Iceland air wants to allocate the capacity of aircraft for each booking class on the designated routes to Keflavik from London (LHR), Paris (CDG) and Frankfurt (FKR) respectively.

In this Task,

a) Calculate the number of passengers in each of the three classes for the three routes. (15 marks)

b) Identify what the objective of the scheduling problem is and write its as a statement?

(5 marks)

c) Identify and define the decision variables. (10 marks)

d) Identify constraints and represent them as mathematical equations

(10 marks)

e) Formulate a linear programming (LP) model.

(10 marks)

f) Create the spreadsheet model for LP with formulas and solve using the Excel Solver. (20 marks)

g) Obtain optimum flight capacity allocation for each booking class (A, B, C) for the three flight routes.

(5 marks)

h) Write your recommendations with optimal flight capacity allocation and projected optimum profit at the regional level.

(5 marks)

TASK-3:

As a Star Alliance member, Iceland Air is planning to have code sharing agreement with British Airways, Air France and Lufthansa to introduce additional routes with stopovers such as i) London Paris Keflavik →LHR-CDG-KEF, ii) Cardiff London Keflavik →CWL-LHR-REY and iii) London Rome Keflavik →LHR-ROM-REY.

Without having to solve the problem quantitatively, explain the impact of code sharing from the perspective of

a) Iceland Air. How will this increase (or otherwise) the passenger traffic?
b) An air passenger. How will this become convenient (or otherwise) for the passenger traffic?

For each of the two perspectives, answer the following

i. Explicitly state your opinion and whether you think it will increase/decrease.
ii. Justify your perspective.

(10 marks)

Submission Instructions:

You will need to submit the following documents:

a) Word document in report format outlining:
   - Data preparation and Descriptive statistics of demand and unit pricing (Task 1)
   - the objective of the decision problem (Task 2)
   - decision variables and constraints (Task 3)
   - the LP model in the excel sheet
   - Presentation of the results of optimal allocation
   - Clearly state what your recommendation to Mark Neumann is?

b) Excel sheet solution containing the proposed problem formulation in Excel solver formulae. For each scenarios have separate excel sheet clearly indicating the task it corresponds to

All the enclosures (spreadsheet and report) must be submitted online using Moodle website (204KM). Your report document should in pdf format and spreadsheet as .xls format. The maximum word count for the report is 1000 words and this excludes spreadsheet.

Coursework 2 Marking Sheet

	<40	40-49	50-59	60-69	>70	100		MAX	*Further Comments*
Task 1	Does not reach the required threshold	Very basic results.	One of calculations not correct and/or formulas not evident.	Correct calculation of annual demand and calculation of weekly average.	Correct calculation of annual demand and calculation of weekly average, using appropriate formulas and/or statistical methods. Excellent presentation of results.		0	10	
Task 2a and 2b	Does not reach the required threshold	Very basic results.	One of calculations not correct and/or formulas not evident.	Correct calculation of number of passengers and objective clearly identified.	Correct calculation of number of passengers and objective clearly identified. Excellent presentation of results.		0	20	
Task 2c-e: Variables, Constraints, Formulation of LP problem.	Fails to develop context for the chosen topic, too superficial	Coverage acceptable to a basic level of awareness with significant omissions.	Reasonable coverage of variables and constraints.	Good explanation of variables and constraints, although lacking a few components.	All decisions variables, constraints etc identified and excellent comments provided. Constraints represented with approporiate inequalities including essential constraints (e.g. nonnegativity constraints)		0	30	
Task 2f-g: Layout of problem solution in report and spreadsheet.	Fails to develop context for the chosen topic, too superficial	Coverage acceptable to a basic level of awareness with significant omissions.	Reasonable coverage of relevant components.	Good explanation of components, although lacking a few components.	Excellent explanation of relevant components with clear defined comments. High quality screenshots used to supplement explanations. LP Formulation accurately transferred into Spreadsheet. Constraints represented using inequalities.		0	25	

Task 2h: Recommendations	Fails to develop context for the chosen topic, too superficial	Coverage acceptable to a basic level of awareness with significant omissions	Reasonable coverage of subject with acceptable depth of contextual understanding	Shows good depth of understanding & appreciation of real-world situations surrounding the subject	Excellent – evidence gathering & analysis. Interpreted solver results to find optimum allocation, optimum profit and clearly stated the recommendations. With originality & creativity in application to practical contexts		0	5	
Task 3	Does not reach the required threshold	Very basic or partial explanation of impact.	Adequate explanation with some points omitted.	Good explanation of impact from both Iceland Air and Air passenger perspectives. Good justification for own perspective.	Excellent explanation of impact from both Iceland Air and Air passenger perspective. Excellent justification for own perspective.		0	10	

END.