A case study on employer's engagement in coursework

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University of Plymouth

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IMS/RSS Higher Education Teaching and Learning Series

Institute of mathematics & its applications

ROYAL STATISTICAL SOCIETY
DATA | EVIDENCE | DECISIONS

UNIVERSITY OF PLYMOUTH

European Union
European Social Fund

Context

- 2nd year BSc (Hons) Mathematics (and other maths programmes) at the University of Plymouth
- Module: "Operational Research and Monte Carlo Methods"
- Compulsory module, focused on employability skills
- Module aims and learning outcomes
  - To develop practical skills that can be used directly in a workplace
  - To apply mathematics to solve real life problems
  - To improve students' computer and programming skills
  - To refine students' communication skills and cooperation with others through teamwork
  - To practice presentation skills

Assessed learning outcomes

"At the end of the module you will be expected to be able to:

- solve particular problems in OR
- demonstrate proficiency in using computer programming to solve particular problems in the field of Monte Carlo methods and modelling
- demonstrate an awareness of personal proficiency in various key skills and the need to match career plans with these
- co-operate with others in producing a piece of work
- communicate the results of the analyses through oral presentations and written reports"

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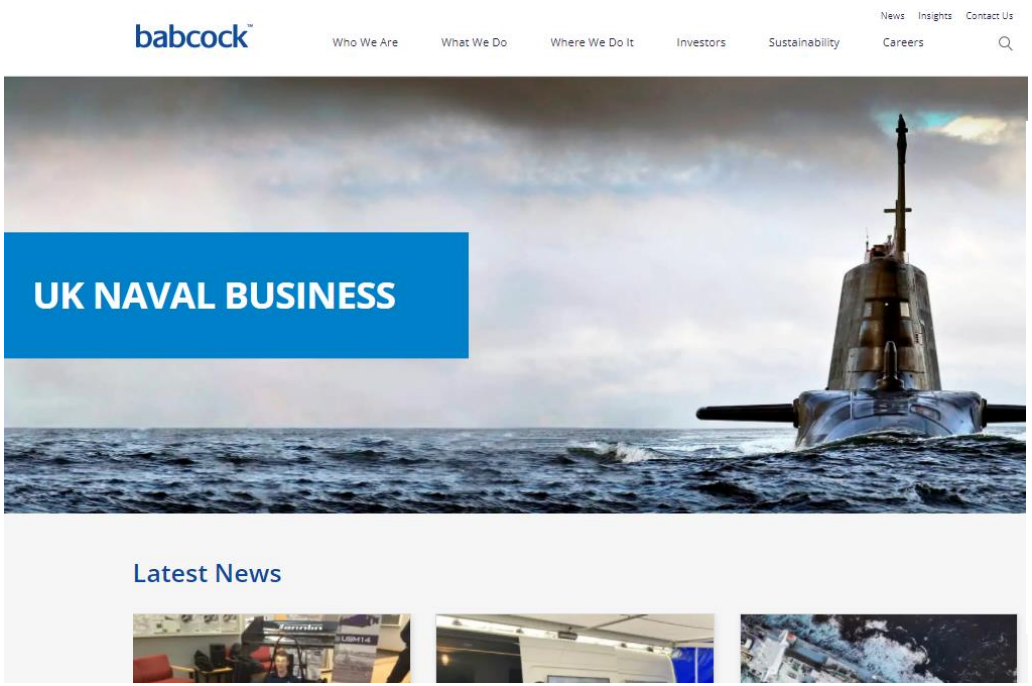
Module structure

- Module contents:
  - Risk analysis (weeks 1-6), using *MS Excel*
  - Queuing systems (weeks 7-12), using *SIMUL8*
  - Series of tasks on Monte-Carlo methods using *Python* and reflective report on employability skills (weeks 1-12)
- Assessments:
  - 100% Coursework, no exam
  - Report, presentation, portfolio
- A “hands-on” module: students work independently on open-ended case studies to develop these skills

The employer

- Babcock Intl. (www.babcockinternational.com)
- International aerospace, defence and security company.

trusted to deliver



Our Focus Areas

UK naval business | UK value-add services | International

Owns key sites and infrastructure including the Devonport and Rosyth dockyards

Deep technical expertise across critical and complex engineering

Customer relationships

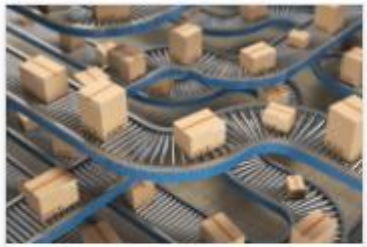
Find out more ›

The employer

- Members of External Advisory Panel
- UoP graduates
- Present at job fairs, project showcases, etc.
- Supply chain management

babcock

trusted to deliver



Our Supplier Requirements

Supply Chain Responsibility

Becoming a Supplier

High Calibre Procurement

Coursework tasks

- Database of items held in warehouse
- Mimicking real data - confidentiality

	A	B	C	D	E	F	G	H	I
1	Part number	Employee ID	Reason for demand	Quantity	Customer ID	Demand date	Purchase order date	Expected delivery date	Actual delivery date
2	633334498	4430	C	1	7760	13/11/2020	16/11/2020	24/11/2020	24/11/2020
3	486979815	8300	X	40	8925	25/03/2019	29/03/2019	29/03/2019	29/03/2019
4	279471581	3357	X	33	9886	21/05/2021	24/05/2021	30/05/2021	30/05/2021
5	279471581	6736	M	10	1854	23/10/2020	26/10/2020	01/11/2020	01/11/2020
6	164587081	2204	M	33	2454	23/04/2019	24/04/2019	29/04/2019	29/04/2019
7	775568751	3357	C	41	8181	06/09/2019	09/09/2019	12/09/2019	15/09/2019
8	984917092	4430	C	6	1117	06/12/2019	09/12/2019	16/12/2019	16/12/2019
9	601793540	4430	X	1	2070	30/10/2020	04/11/2020	05/11/2020	05/11/2020
10	653193771	8300	X	15	3849	11/09/2019	16/09/2019	13/09/2019	13/09/2019
11	279471581	6736	M	32	9623	30/10/2020	02/11/2020	08/11/2020	08/11/2020
12	984917092	4430	M	17	6305	10/07/2020	13/07/2020	20/07/2020	20/07/2020
13	486979815	3357	M	26	6891	03/10/2019	04/10/2019	07/10/2019	07/10/2019
14	984917092	3357	X	20	3979	09/07/2021	12/07/2021	19/07/2021	19/07/2021
15	486979815	3357	M	2	7429	13/02/2019	18/02/2019	17/02/2019	17/02/2019
16	421234812	8300	C	1	5502	09/07/2021	12/07/2021	12/07/2021	12/07/2021
17	486979815	4178	M	9	9333	23/04/2019	24/04/2019	27/04/2019	29/04/2019
18	653193771	2204	Z	4	8132	06/05/2019	08/05/2019	08/05/2019	08/05/2019
19	279471581	6736	C	8	2545	12/07/2019	16/07/2019	21/07/2019	23/07/2019
20	653193771	6736	Z	13	5562	05/01/2021	11/01/2021	07/01/2021	07/01/2021
21	984917092	3357	X	4	1443	18/04/2019	22/04/2019	28/04/2019	28/04/2019
22	164587081	8300	X	11	6041	18/12/2019	19/12/2019	24/12/2019	24/12/2019
23	279471581	4178	X	21	3072	26/06/2020	30/06/2020	05/07/2020	05/07/2020

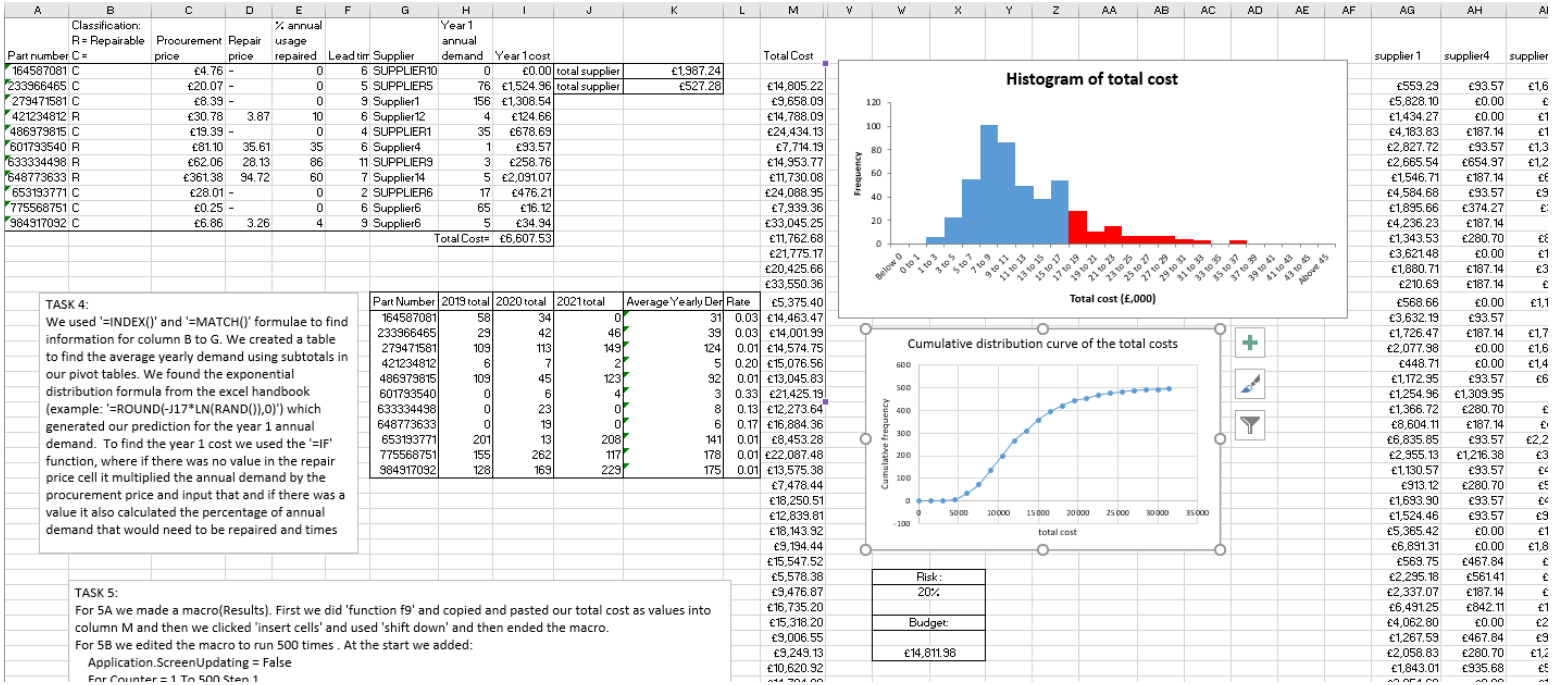
Coursework tasks

- Data cleansing
- Assess quality
  and reliability of data sources
- Collate data sources
  to create reliable information
- Investigate the pattern
  of demands/costs over years

	A	B	C	D	E
1	Part number	Supplier	Lead Time	Validity	Price
2	775568751,	SUPPLIER7	4	18/02/2021	£ 0.47
3	279-471-581	SUPPLIER5	10	19/10/2018	£ 7.05
4	775568751	SUPPLIER3	6	01/09/2017	£ 0.60
5	984917092	SUPPLIER2	10	12/06/2020	£ 6.91
6	633334498	HISTORIC	20	01/01/2015	£ 63.17
7	653193771	SUPPLIER8	2	31/07/2017	£ 27.91
8	164587081	SUPPLIER5	5	25/09/2017	£ 5.87
9	984917092	HISTORIC	20	01/01/2015	£ 6.27
10	984-917-092	SUPPLIER10	11	18/11/2019	£ 5.92
11	486979815	HISTORIC	20	01/01/2015	£ 18.69
12	279471581	HISTORIC	20	01/01/2015	£ 8.82
13	233966465	SUPPLIER5	5	19/11/2021	£ 20.07
14	775568751	HISTORIC	20	01/01/2015	£ 0.05
15	164587081	SUPPLIER10	6	19/11/2021	£ 4.76
16	601793540	HISTORIC	20	01/01/2015	£ 81.42
17	633334498,	SUPPLIER9	11	13/10/2021	£ 62.06
18	233966465	SUPPLIER2	4	21/07/2020	£ 19.30
19	421234812	SUPPLIER9	5	12/01/2018	£ 30.92
20	653193771	SUPPLIER6	2	06/08/2021	£ 28.01
21	648773633	SUPPLIER1	9	12/06/2017	£ 363.39
22	653193771	HISTORIC	20	01/01/2015	£ 27.83
23	486979815_	SUPPLIER3	7	21/09/2018	£ 18.46
24	486979815	SUPPLIER1	4	04/11/2021	£ 19.39
25	601-793-540	SUPPLIER1	6	24/10/2017	£ 82.54
26	633334498	SUPPLIER1	9	08/01/2021	£ 63.94
27	601793540	SUPPLIER2	8	29/05/2018	£ 82.48
28	279471581	SUPPLIER9	8	04/05/2018	£ 7.29
29	421234812	HISTORIC	20	01/01/2015	£ 30.92

Coursework tasks

- Forecast the demand and costs using simulations
- Investigate the risk that the cost will exceed a given threshold.
- Which supplier is responsible for the largest portion of the forecast cost? Etc…



Part number	Classification: R = Repairable C =	Procurement price	Repair price	% annual usage repaired	Lead time	Supplier	Year 1 annual demand	Year 1 cost			Total Cost
164587081	C	£4.76	-	0	6	SUPPLIER10	0	£0.00	total supplier	£1,987.24	£14,805.22
233966465	C	£20.07	-	0	5	SUPPLIER5	76	£1,524.96	total supplier	£527.28	£9,658.09
279471581	C	£8.39	-	0	9	Supplier1	156	£1,308.54			£14,788.09
421234812	R	£30.78	3.87	10	6	Supplier12	4	£124.66			£24,434.13
486979815	C	£19.39	-	0	4	SUPPLIER1	35	£678.69			£7,714.19
601793540	R	£81.10	35.61	35	6	Supplier4	1	£93.57			£14,953.77
633334498	R	£62.06	28.13	86	11	SUPPLIER9	3	£258.76			£11,730.08
648773633	R	£361.38	94.72	60	7	Supplier14	5	£2,091.07			£24,088.95
653193771	C	£28.01	-	0	2	SUPPLIER6	17	£476.21			£7,939.36
775568751	C	£0.25	-	0	6	Supplier6	65	£16.12			£33,045.25
984917092	C	£6.86	3.26	4	9	Supplier6	5	£34.94			£11,762.68
							Total Cost=	£6,607.53			£21,775.17
											£20,425.66
											£33,550.36
											£5,375.40
											£14,463.47
											£14,001.99
											£14,574.75
											£15,076.56
											£13,045.83
											£21,425.19
											£12,273.64
											£16,884.36
											£8,453.28
											£22,087.48
											£13,575.38
											£7,478.44
											£18,250.51
											£12,839.81
											£18,143.92
											£9,194.44
											£15,547.52
											£5,578.38
											£9,476.87
											£16,735.20
											£15,318.20
											£9,006.55
											£9,249.13
											£10,620.92

TASK 4:
We used '=INDEX()' and '=MATCH()' formulae to find information for column B to G. We created a table to find the average yearly demand using subtotals in our pivot tables. We found the exponential distribution formula from the excel handbook (example: '=ROUND(-J17*LN(RAND()),0)') which generated our prediction for the year 1 annual demand. To find the year 1 cost we used the '=IF' function, where if there was no value in the repair price cell it multiplied the annual demand by the procurement price and input that and if there was a value it also calculated the percentage of annual demand that would need to be repaired and times

Part Number	2019 total	2020 total	2021 total	Average Yearly Der	Rate
164587081	58	34	0	31	0.03
233966465	29	42	46	39	0.03
279471581	109	113	149	124	0.01
421234812	6	7	2	5	0.20
486979815	109	45	123	92	0.01
601793540	0	6	4	3	0.33
633334498	0	23	0	8	0.13
648773633	0	19	0	6	0.17
653193771	201	13	208	141	0.01
775568751	155	262	117	178	0.01
984917092	128	169	223	175	0.01

TASK 5:
For 5A we made a macro(Results). First we did 'function f9' and copied and pasted our total cost as values into column M and then we clicked 'insert cells' and used 'shift down' and then ended the macro.
For 5B we edited the macro to run 500 times . At the start we added:
Application.ScreenUpdating = False
For Counter = 1 To 500 Step 1

Risk :
20%
Budget:
£14,811.98

supplier 1	supplier4	supplier
£559.29	£93.57	£1,6
£5,828.10	£0.00	£
£1,434.27	£0.00	£1
£4,183.83	£187.14	£1
£2,827.72	£93.57	£1,3
£2,665.54	£654.97	£1,2
£1,546.71	£187.14	£
£4,584.68	£93.57	£9
£1,895.66	£374.27	£
£4,236.23	£187.14	
£1,343.53	£280.70	£
£3,621.48	£0.00	£1
£1,880.71	£187.14	£3
£210.69	£187.14	£
£568.66	£0.00	£1,1
£3,632.19	£93.57	
£1,726.47	£187.14	£1,7
£2,077.98	£0.00	£1,6
£448.71	£0.00	£1,4
£1,172.95	£93.57	£6
£1,254.96	£1,309.95	
£1,366.72	£280.70	£
£8,604.11	£187.14	£
£6,835.85	£93.57	£2,2
£2,955.13	£1,216.38	£3
£1,130.57	£93.57	£
£913.12	£280.70	£
£1,693.90	£93.57	£
£1,524.46	£93.57	£9
£5,365.42	£0.00	£1
£6,891.31	£0.00	£1,8
£569.75	£467.84	£
£2,295.18	£561.41	£
£2,337.07	£187.14	£
£6,491.25	£842.11	£1
£4,062.80	£0.00	£2
£1,267.59	£467.84	£9
£2,058.83	£280.70	£1,2
£1,843.01	£935.68	£5

Implementation

- 2 weeks of introduction: learn skills necessary for coursework
  - Random sampling in MS Excel
  - Writing macros and running simulations
  - Data cleansing
  - Pivot tables
  - Handbook to work through
- 4 weeks of independent work
  - including during weekly classes in computer rooms
- Students work in groups of 3 or 4
  - Minutes. Marks are awarded for minutes.
  - Peer assessment.

Implementation

- Employer's visit in the first session
- Formative feedback – during classes
- Summative assessment: spreadsheet and written report.
- Feedback to employer:
  - best submissions,
  - possible placements, …

Evidence and recommendations

Regarding module **contents**, aspects that stood out to students:

- practical
- real-world
- software
- relevant for employment

"The content was interesting and the skills learnt will be beneficial after the degree."

"I loved the accent they put on employability and made sure we had plenty of opportunities for placements etc."

"It was a very practical module which I enjoyed with a specific real life application."

"The best aspect was learning how to use new software and techniques"

Evidence and recommendations

Regarding **mode of delivery**,

- apprehensive about change
- plenty of time for work
- clear, practical handbook

"Module itself was very self-taught which was a change that took getting used to."

"The research aspect was great. The fact that we got a module where it wasn't a "theory, practice, memorise, exam" style was very nice. It also gave a real feel for what real world work is like."

"I liked the amount of contact time with tutors in the computer lab."

"Workbooks on Excel and SIMUL8 were very useful and easy to follow."

Evidence and recommendations

Regarding the **coursework**,

- not always clear what to do,
- enjoyable

"Interesting real-world case studies to look at and analyse"

"Thoroughly enjoyed trying to solve real-world problems"

"The best aspect was that it was coursework based module this was less stressful assessment method than exam"

"Risk analysis coursework could be made clearer as instructions seemed quite open ended and the quality of the spreadsheet was inconsistent."

Evidence and recommendations

- Risk:
  - Students' expectations not aligned with the purpose of the module.
  - Students confused, lost, stressed, overwhelmed.

- Communication with students!
  - why we are doing this,
  - what they should expect.

- With this, students appreciate the experience, enjoy it, benefit and consciously develop the skills.

- Issues with peer assessment
  - Anonymous?

Thank you!