Solutions Exercise 1 - Material classification

Inventory Management

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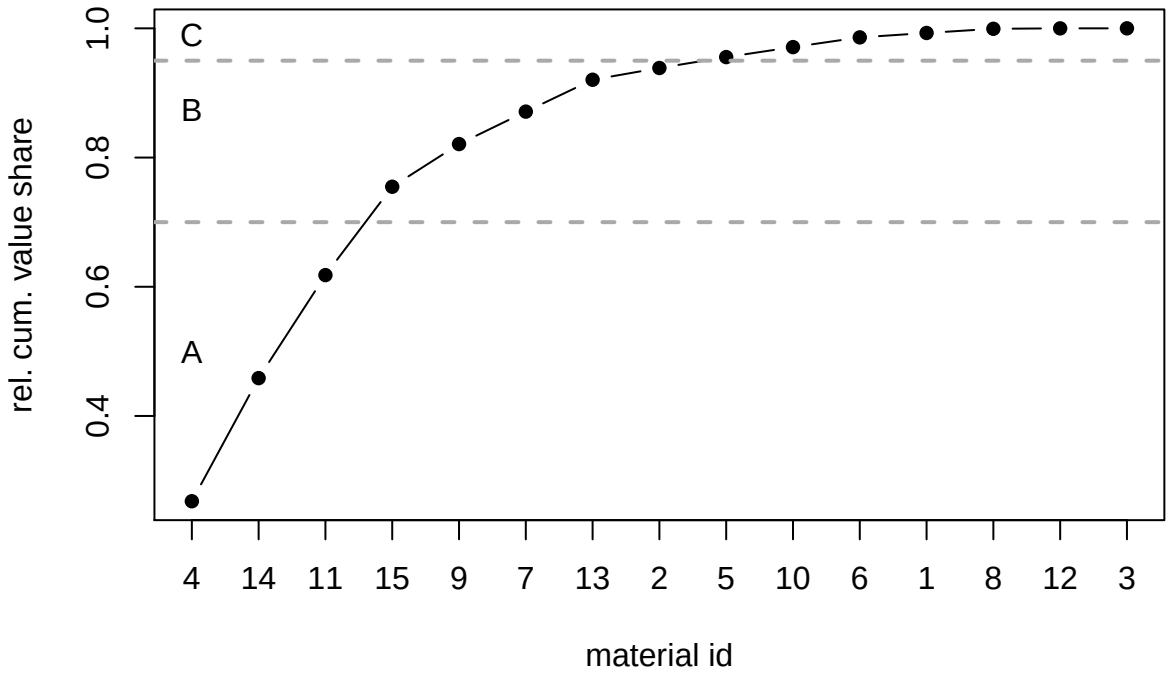
ABC analysis

(1) Determine on the basis of these data a classification of the materials in A, B, and C.

Hint: Compute the material consumption values first.

Table 1: ABC analysis results

ord.material.id	price..ord..	demand..ord..	mat.values	cum.mat.values	rel.cum.value.shares	class
4	11.62	734	8529.08	8529.08	26.8	A
14	20.35	298	6064.30	14593.38	45.9	A
11	12.53	405	5074.65	19668.03	61.8	A
15	11.67	373	4352.91	24020.94	75.5	B
9	5.59	376	2101.84	26122.78	82.1	B
7	5.49	291	1597.59	27720.37	87.1	B
13	11.06	142	1570.52	29290.89	92.0	B
2	1.65	351	579.15	29870.04	93.9	B
5	2.58	208	536.64	30406.68	95.6	C
10	5.07	97	491.79	30898.47	97.1	C
6	0.60	799	479.40	31377.87	98.6	C
1	16.68	13	216.84	31594.71	99.3	C
8	1.35	153	206.55	31801.26	99.9	C
12	10.64	2	21.28	31822.54	100.0	C
3	0.04	6	0.24	31822.78	100.0	C



Logarithmized accuracy ratio

(2) Estimate the expected logarithmized accuracy ratios (LAR) and the expected squared LAR by using two different estimators.

Table 2: Forecast analysis

period	demand	forecasts	for.err..FE.	sq.FE	LAR	sq.LAR
1	383	NA	NA	NA	NA	NA
2	327	383	-56.0	3136.0	0.158	0.025
3	288	361	-72.6	5270.8	0.225	0.051
4	361	332	29.4	864.4	-0.085	0.007
5	372	343	28.7	823.7	-0.080	0.006
6	405	355	50.2	2520.0	-0.132	0.017
7	410	375	35.1	1232.0	-0.090	0.008
8	385	389	-3.9	15.2	0.010	0.000
9	388	387	0.6	0.4	-0.002	0.000
10	429	388	41.4	1714.0	-0.101	0.010
mean	375	368	5.9	1730.7	-0.011	0.014
median	384	375	28.7	1232.0	-0.080	0.008

(3) What is the expected forecasting error (FE) for each material? Do you find differences?

Mean and median differ as the median is less sensitive to outliers. However, in expectation both estimators deliver identical measures of location (provided the forecasts are unbiased).

ABC/RSU analysis

(4) Conduct an RSU analysis based on these information using both forecasting accuracy measures. What are appropriate thresholds for material categorization? Can you find reasonable thresholds for ESLAR and ESFE such that all materials are categorized identically?

Reasonable thresholds might be 100 and 750 for ESFE as well as 0.005 and 0.1 for ESLAR

Table 3: RSU classification for materials 1-15

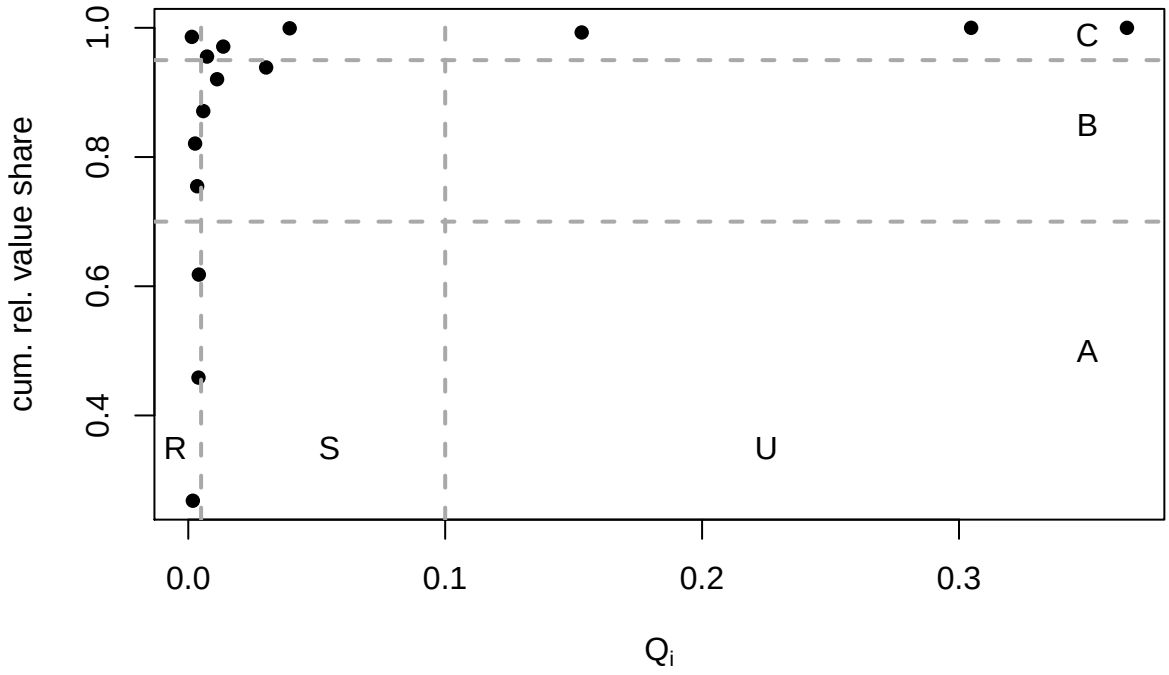
ord.material.id.ESFE.	ESFE	class.ESFE	ord.material.id.ESLAR.	ESLAR	class.ESLAR
12	1.6	R	6	0.001	R
3	7.9	R	4	0.002	R
1	24.8	R	9	0.003	R
10	129.7	S	15	0.003	R
13	227.3	S	14	0.004	R
5	309.9	S	11	0.004	R
14	364.1	S	7	0.006	S
9	371.1	S	5	0.007	S
15	471.6	S	13	0.011	S
7	520.7	S	10	0.014	S
11	668.2	S	2	0.030	S
8	896.6	U	8	0.039	S
6	913.7	U	1	0.153	U
4	944.4	U	3	0.305	U
2	3661.9	U	12	0.365	U

As the ordering of materials is quite different for ESFE and ELAR (see material 12), there is no constellation of thresholds such that material classification is identical.

(5) Use the material value information and a reasonable thresholds for ESLAR to categorize materials jointly in the ABC/RSU classes. Which recommendations for material provisioning strategies would you deduce?

mat.id	ESLAR	class.RSU	cum.rel.val.share	class.ABC
6	0.001	R	98.60	C
4	0.002	R	26.80	A
9	0.003	R	82.09	B
15	0.003	R	75.48	B
14	0.004	R	45.86	A
11	0.004	R	61.80	A
7	0.006	S	87.11	B
5	0.007	S	95.55	C
13	0.011	S	92.04	B
10	0.014	S	97.10	C
2	0.030	S	93.86	B

mat.id	ESLAR	class.RSU	cum.rel.val.share	class.ABC
8	0.039	S	99.93	C
1	0.153	U	99.28	C
3	0.305	U	100.00	C
12	0.365	U	100.00	C



Recommendations:

- AU ⇒ VMI/consignment warehouse (CW)
- AS ⇒ VMI/JIT
- AR ⇒ JIS/JIT
- BU ⇒ ind-proc./VMI
- BS ⇒ VMI
- BR ⇒ VMI/JIT/JIS
- CU ⇒ WH/VMI
- CS ⇒ WH
- CR ⇒ WH

IQR analysis

Each of the 15 materials is stored in an inbound warehouse which is operated as a consignment warehouse by the supplier. The supplier assess the storage space assignment regularly. The following table reports the average stock levels (in units) for each of the materials.

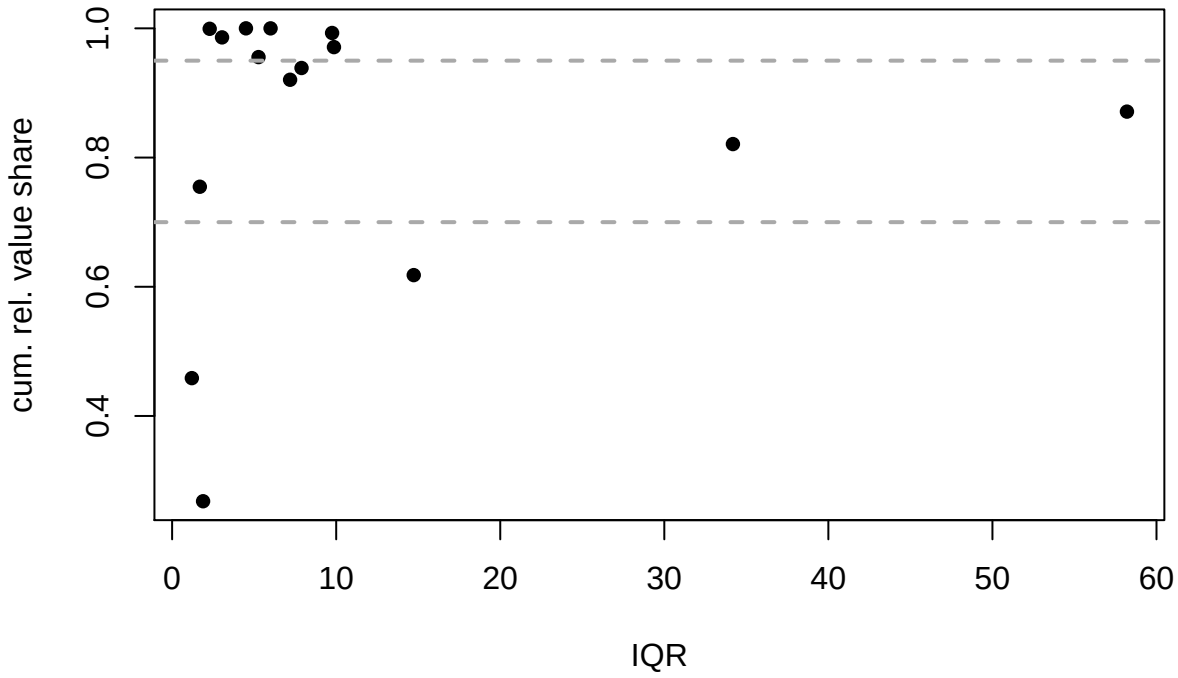
The materials should be categorized as "no mover", "slow mover", and "fast mover" based on the IQR methodology. Assume that a material's accepted turnover time o_i is based on its corresponding ABC ranking. Use the values given on the lecture slides for classes A,B, and C.

(6) Use the all information about the 15 materials to calculate the active inventory, excess inventory, and inventory quality ratio. Categorize the materials according to their IQR ratios (use the thresholds from the lecture slides).

Thresholds used are: A. . . 4 per., B..8 per. and c..12 per. The definition of IQR used here is $IQR_i = \frac{to_i}{s_i}$ (to.value/stock.value).

Table 5: Life-cycle analysis for materials 1-15

material.id	stock.value	to.value.act.inv	iqr	excess.inv
1	133.4	1301.0	9.8	-1167.6
2	293.7	2316.6	7.9	-2022.9
3	0.3	1.4	4.5	-1.1
4	9040.4	17058.2	1.9	-8017.8
5	611.5	3219.8	5.3	-2608.4
6	945.6	2876.4	3.0	-1930.8
7	109.8	6390.4	58.2	-6280.6
8	541.4	1239.3	2.3	-698.0
9	246.0	8407.4	34.2	-8161.4
10	299.1	2950.7	9.9	-2651.6
11	689.1	10149.3	14.7	-9460.1
12	21.3	127.7	6.0	-106.4
13	873.7	6282.1	7.2	-5408.3
14	10093.6	12128.6	1.2	-2035.0
15	10316.3	17411.6	1.7	-7095.4



(7) Which recommendations for the stock holding processes do you deduce for each material?

As all IQR values are greater than 1, for all materials higher stock levels should be realized. Particularly, A and B materials with IQR values > 10 might be critical.