

DEMAND FORECASTING AT M&S

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M&S

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First steps in the application of ML techniques to deliver demand forecasting and product fulfilment improvements at M&S

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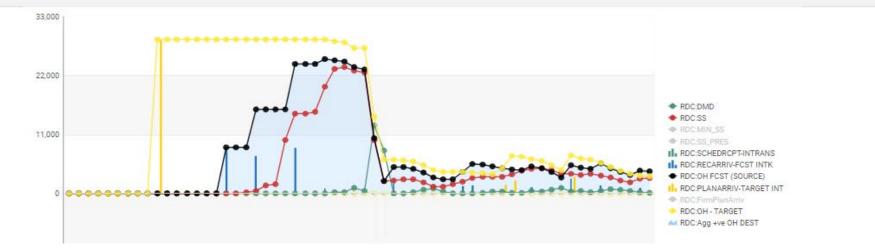
Summary

- New forecasting methods including machine learning offer the prospect of improved forecast accuracy and higher product availability.
- They need to be effectively incorporated into the demand forecasting processes of the organization.
- The session will explain the approach taken in M&S Clothing and Home to date including the tools and skills used.
- It will also reflect on learnings so far and a vision of a future incorporating advanced analytics into everyday operational processes.

DEMAND FORECASTING AT M&S

- Demand and Fulfilment teams in each Business unit
- Centralised Supply Chain development supporting
- Planning c20m SKUs
- Planned in JDA Demand and Fulfilment
- 2 main algorithms used, JDA Lewandowski and AVS Graves at store level
- Lost sales calculated in JDA
- New product forecasting based on commercial estimate + shape

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The JDA Moonshot

Blue Yonder acquired to enhance traditional forecasting capability

Digital Supply Chain Maturity



Visibility

- Managing constraints
- Multi-source integration

Predictive Analytics

Using big data & predictive Algorithms:

Predict issues

Prescriptive Supply Chain

Powered by Machine learning:

 Prescribing course of action to resolve problems Self-Learning Supply Chain

Enabled by deep learning:

- Anticipate
- Sense
- Act
- Analyze
- Learn
- Adjust strategies



Autonomous

Differentiation

ADVANCING TECHNIQUES COMBINED WITH TRADITIONAL METHODS

All M&S Clothing a& Home lines have a seasonal profile

A seasonal profile is essentially the shape of sales across a selling period, showing peaks and troughs

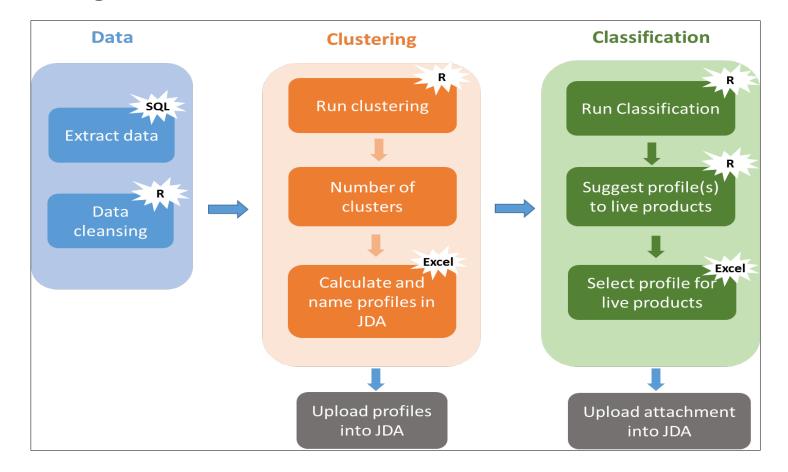
They are essential for 2 reasons:

- 1. Direct the shape of forecast
- 2. Enable effective cleansing of history

with which to make a forecast

SEASONAL PROFILING

Seasonal Profiling Creation Process



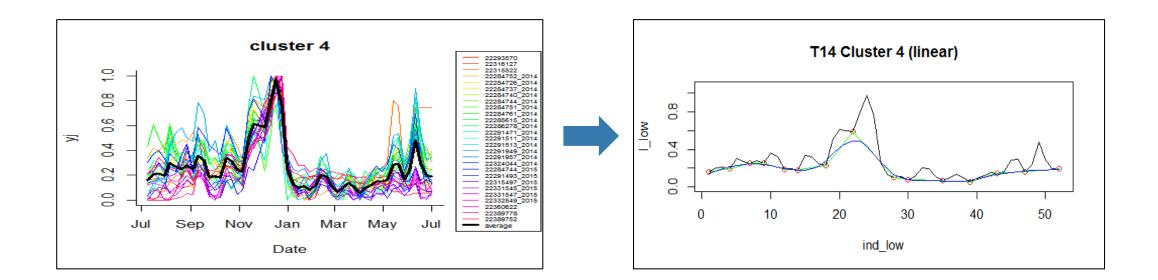
Academy

M&S Learning and Development

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SEASONAL PROFILING

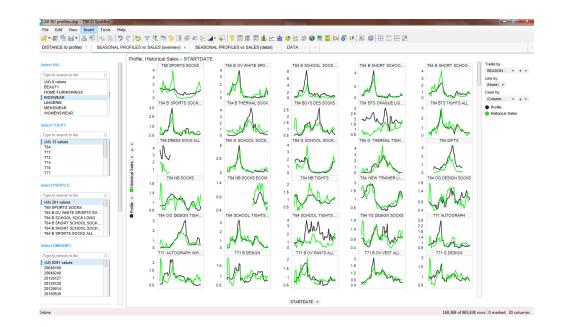
- 1. For each cluster, a shape is created (average of cluster components)
- 2. Smooth : we want to remove non-seasonal spikes (random, promotions) and keep the seasonal spikes (Easter, Father's day, Christmas etc..)



SEASONAL PROFILING

- A dashboard was created to assess the accuracy and suitability of the shapes
- Product sales are compared to their profiles

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	Weighted distan	ce by profile																			
t BU:	KIDSWEAR																				
6 values	T64 DRESS SOCK	T76 GIRLS SLIM FIT 1.15	T64 B SCHOOL SOCK LONG ALL 0.95	192 B/G ICON 0.78	T72 BOYS SLIPPERS 0.71		T79 PKT MONEY- DINO/GRAE BERS 0.58	T76 GIRLS KNITTED PINAFORE ALL 0.54	T92 BAGS YOUNGER 0.51	T87 SWIMWE/ R 0.51	A 179 BAB BOOK 0.50	DRESS GOW	N ECI 0.5	ZER THE DM TO SO 0	RMAL CHI SPS E 50 (NON- RACT T (50	IBISS OPS 1.50	T77 SHORTS T 0.49	FF OV ROUSER S ECOM 0.49	SKIRTS 0.49	H/HAT ARE YOUNI 0.49
ME FURNISHINGS SWEAR SERIE ISWEAR	ALL 2.04	T64 SCHOOL	178 ROMPERS	T72 HOLIDAYS 0.77	T79 SOFT TOYS 0.71	T79 ACTIVITY TINICASE 0.66	T76 GIRLS SPORTSWE AR ECOM 0.58	SKIRTS 0.53	WELLIES 0.48	HOODIESI SWEATER S 0.46	FORMAL 0.46	SPORTS T-SHIRTS ECOM 0.46	T74 JEANS CORE 0.45	176 BOY JOGGEF S ALL 0.45	BLAZER ALL 0.45	T88 JEANS 0.44	GIRLS PLUSFI1 BLOUSE 0.44	WARM H/HAT/SC ARF OLDER	T78 FRILLY KNICK 0.44	BOYS TROUSE R ALL COLOU	T8 FLEE SWEA
MENSWEAR		TIGHTS LIGHT ALL 1.07		TT6 BOYS		T79 H48D	T76 GIRLS JUNIOR TROUSER ECOM	T96 PLAY LEARN 0.53	T77 SWM/WEA R 0.48	T64 G SCHOOL SOCKS WHITE	SPORTS SOCKS 0.42	T78 DESIGN \$\$ 85 0.42	772 G BTS FW ALL 0.42	T74 SWEATS CARDIS 0.42	GIRLS GLITTER SHOES	T92 LUNCHB OXES 0.42	T87 SHIRTS 0.42	T78 NEW SLEEPIN G BAGS 0.42	T76 BOYS SS SHIRT COLOUR ALL	JEANS 0.41	TBB I TOP 0.4
to search in list	T76 GIRLS JUNIOR BLOUSE ECOM 1.82	T76 GIRLS COTTON DRESS	174 OCCASION DRESSES 0.86		PUZZLES 0.71	TOYS 0.65	0.57 T92 SUNGLASS ES	T79 SOUND BOOKS 0.53	T76 GIRLS PV DRESS ALL 0.48	T96 NB SOFT TOYS EASTE	T76 BOYS LS OV SHIRT	TT6 BOYS SPORTS T-SHIRTS ALL	187 JEANS 0.40	T72 BOYS SHOES 0.40	TT6 BOYS PF TROUSER ECOM	T72 B BTS FW ALL 0.40	T74 CASUAL/ KNIT DRESS	T87 BTS COATS 0.39	SPORTS SHORTS BLACK	T78 MATERNI TY CASUA	T96 I SOF TOY 0.3
13 values		ECOM 1.07	T72 GIRLS FASHION BOOTS 0.85	T86 2/3PP SHORTIES 0.77	T96 PL BATHTIME 0.71	T92 BAGS OLDER 0.62	0.56 T85	T78 DESIGN LS	T96 NEWBORN SOFT 0.48	T76 BOYS SHORTS ALL 0.43	T88 FORMAL JCKT/SH RT	T78 TOP PACKS 0.39	GIRLS OV DRES	T88 CASUAL JACKET S	S 0	OTTON SPC	WS DES	OG BIGN T78 B CKS 0.3 37	185 TRAIN 7 RS 0.37		BO PLUS SHO
	T74 BTS COATS 1.74			T92 BAGS		172 BOOTS 0.62	T76 GIRLS	T76 GIRLS MYSIZE	T87 SS TOPS POLO	T76 GIRLS SKIN KIND	T78 MATERNI TY JEANS/	T76 BOYS TANK TOP ALL 0.39	TT6 BOYS TROUSE R ALL	1777 JEGGIN GS 0.36	T87 CHINOS S NEW SI 0.36 S	HORT OUT	EW RE	96 T7. SHTD KNITI ESS EA N-C 0.3	SW TOPS	S SANDS	SWI EA
t PROFILE:		T79 STORYBOOKS 1.02	SHORTS ECOM	GLITTER 0.77	BOOTS 0.70	T76 GIRLS CORE	IRON BLOUSE ECOM	SHORT/TA LL 0.52	0.48 T76 BOYS FF	T76 GIRLS KNITTED	T64 BOYS DES	T87 SS TEES 0.39	T76 GIRLS JUNIOR TROUS	T79 EDUCAT IONAL - OTHE	SHOES SO	HUUL PIL	715 H/	78 BOYS ATS RIC 34 JUM		IO RATTLE	BOY BOY JUM
to search in list 281 values SPORTS SOCKS	T76 GIRLS CORE PINAFORE ECOM 1.61 T87 FORMAL OUTFITS	1.02	T76 BOYS FF OV TROUSERS ENG 0.84	179 ACTIVITY OTHER 0.76	TB6 CHARACTE R PJ 0.70	TROUSER ECOM 0.62	T76 BOYS LS NON- IRON SHIRT ECOM 0.55	T74 SL TOPS 0.52	TROUSER ECOM T92 UMBRELLA	TROUS	SOCKS T76 GIRLS SPORTS	T78 DESIGN TOPS 0.38	T64 G THERMA L TIGHTS 0.36	T76 GIRLS SENIOR 2PK B	ERS EE	EC LIN	NER TRO	87 T7 DUSE TROU PU RS.	UITS.	PS EDUCA IONAL	ov o
B OV WHITE SPORTS B SCHOOL SOCK LOI B SHORT SCHOOL SC		TE6 NON- CHARACTER AIO 1.00 TT6 GIRLS PLUSFIT SKIRT 0.98			T76 GIRLS SKIRT	SLIPPERS 0.61	T86 NIGHTDRES S CHARACTE	CTE TOPS 0.52 T76 GIRLS BLAZERS SCOT 0.52 T76 GIRLS CORE	S 0.47 T64 YG DESIGN	DRESSES 0.43 T77 CASUAL/	TB6 SHORTIE	T88 CASUAL OUTFITS/ JOGGE	L SWIMWE LUT AR 0 0.36 EO Y T88 1 TROUSE JAI RS 0.36 0 1774 TT	T92 LUNCHB OXES ECOM	ICHOO SC	4 NB ICKS LAYE G. 32	RIN TOP	SS 176 PS GIRL 81 SS NO	5 TIGHTS 0 0.31	3 CORE LS BS	s 5HO 0.3
B SHORT SCHOOL SC B SPORTS SOCKS AL					SKIRT ECOM 0.69	T64 B THERMAL SOCK 0.59	R T76 GIRLS PLUSFIT DRESS		SOCKS 0.47	KNIT DRESS	S 0.40 176	T72 BABY SHOES 0.38		T78 JACKET L S 0.34	LEGGIN LEG GS G 0.33 0.3	G NON	LS GIRL SENI R 2P.	S GIRLS O COTTO N CA	AIO/DU C NGARE S ES 0	ORE SCH S BS OL 0.29 TIGH	IO GIÍ FA I ON
DMDUNIT:	1.34		T76 UNISEX POLOS ECOM 0.82		T79 POCKET MONEY 0.69	T87 SS TOPS CHARACTE	DRESS ECOM 0.55 T76 BOYS JOGGERS		WINTER LAYERING 0.47 T88	TOPS 0.43	GIRLS OV TROUS T87	T78 CASUAL DRESSES 0.38			DESIGN SF	SA B AUTO	GR CEAM	SMAID SHO	FORM AL Y OUT S	OV GIR WHITE OV SPO SKIP	ії́ 5 мі V 1 R 90 76 Т
9291 values 48160	176 GIRLS OV CARDI ECOM 1.31	T64 BTS OPAQUE LIGHT 0.97	T76 BOYS LS OV SHIRT	T71 THERMAL BOTTOMS 0.73	T87 KNITWEAR 0.69	R 0.59 T79 ACTIVITY	ECOM 0.55	TROUSER ALL 0.62 T92	FLEECE/K NITWEAR 0.47	GIRLS SENIOR TROUS	OUTERW EAR JACKE	T74 SS T	T64 NB SOCKS 0.36	T96 NB COMFO RTERS AND P	BASIC JC	RS T7 GIR SKIR SKIR SKIR GGE T7 GIR	5 T76	5 176	FF T 1 T72 G SCH	OV GIR WHI SS 1 178 164	RLS B
48240 26127 26128					0.69	ACTIVITY STICKERS 0.58	T96 PL TOYS 0.54	WATERBO TTLES 0.51	T76 BOYS SKIN KIND 0.46	T72 FLIP FLOPS CLG 0.43	OUTERW EAR 0.40	T76 GIRLS FASHION PINAFO	T72 GIRLS SHOES 0.36		T71 T76 BOYS RAPH OV 0.33 JUMP	ov 10	V MYSG 9 T76 CYB GIRI	Z PF TR 5 T87 LS SUITS	T78 ROOTI	HOOD GIF	OR BL C SU 76 17 RLS 0
26614 50539	179 CRAFT 1.19	T72 BTS TRAINERS 0.97	T86 CHARACTER AIO 0.80	T76 GIRLS PLUSFIT TROUSER	187 SHORTS 0.67	T78 BODYSUITS	T85 2/3PP PV JAMAS	T64 OG DESIGN TIGHTS	T78 SHAWLS	T74 SHORTS	T74 OUTERW EAR	T77 TROUSE	T76 GIRLS	T76 BOYS	172 BELTS G	AZE SEN	_	E 0.26 B T76	ES 176	ED T LS	N W



In case of bad accuracy:

- 1. Attach another existing profile
- 2. Or refresh the profiles: this will not update profiles individually but all the profiles (because of the clustering)
- M&S Learning and Development Academy

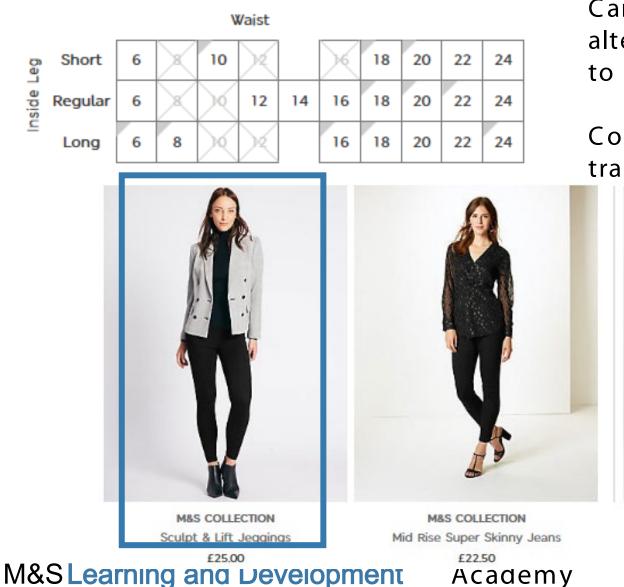
DEVELOPMENT WITH JDA

Leveraging shared analytics capability and technology

- In 2018, M&S & JDA started a project to understand product substitution
- Could we predict what customers would switch to if their first choice product was out of stock on line?

M&S/JDA PARTNERSHIP - COGNITIVE DEMAND





Can Machine Learning be used to identify alternative products that our customers want to buy?

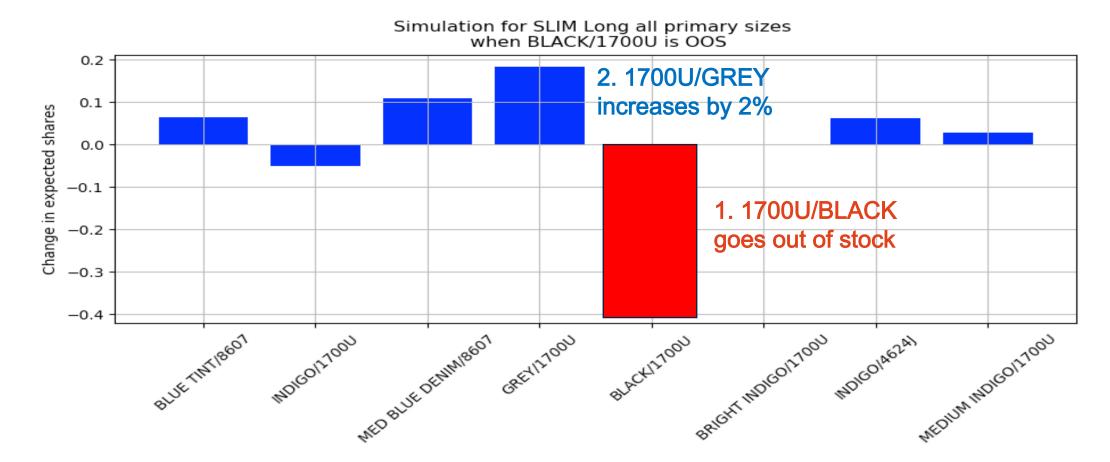
Could an understanding of demand transference improve customer availability?



M&S COLLECTION Cotton Rich Jeggings £15.00 M&S COLLECTION Mid Rise Super Skinny Jeans £19.50

DEMAND TRANSFER



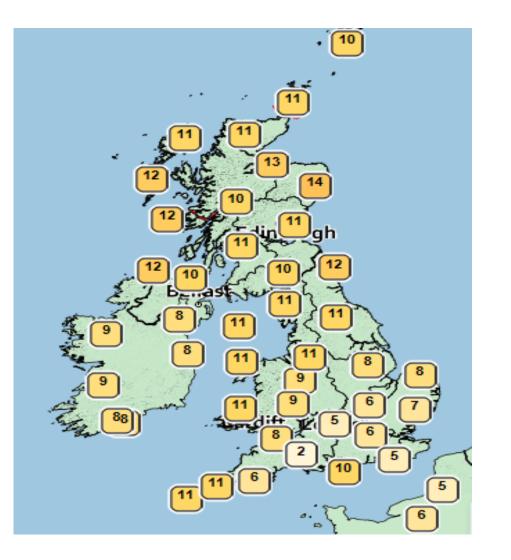


Demand transfer exists - The POC was able to forecast the percentage gain in sales of other items within the group when an item was out of stock.

NEXT STEPS FOR COGNITIVE DEMAND



- Widen the model look at the potential for Demand Substitution in other departments
- Evaluate the application of Demand Substitution demand dashboard alerts vs. auto transfer
- Weather variance investigate regional variations in weather to respond to customer requirements



ANALYTICS & ORGANISATIONAL CONSIDERATIONS

- Hiring the right team rights skills and ability to work in an agile environment
- Onboarding process
- Ability to communicate analysis and help guide the correct questions
- Where should analysts sit? central group or with commercial teams?
- Need better ways to assess performance, and grade analysts
- Progression based on technical competence
- The right training on what tools?
- Retaining analysts while the organisation moves to being data driven
- Starting to collect the right data that will be useful in the future
- Cultural challenges pull for "Allocation" and control
- Should we use the forecast to measure availability?