



Final Project #2 : BOPS

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Background Information

A jewelry store want to figure out the impact of Buy-Online-Pickup-In Store (BOPS) strategies on sales and returns on

- 1) store level
- 2) consumer level
- 3) product level





Research Questions:

- Question 1: What is the impact of implementing BOPS strategy on online channel sales?
- Question 2 : What is the impact of implementing BOPS strategy on online channel returns?
- Question 3 : What is the impact of using the BOPS service on online customer purchase behavior?
- Question 4 : What is the impact of using the BOPS service on online customer return behavior?
- Question 5 : What is the impact of implementing BOPS strategy on product-level sales and returns?
- Question 6 : How does the impact of implementing BOPS strategy vary across product categories?

1) Store Level



Q1 : What is the impact of implementing BOPS strategy on online channel sales?



	Dependent Variable	Key independent Variable	Control Variable
Model 1	Sales value	Times*Group	Female Age Income
Model 2	Sales quantity	Times*Group	Month_dummy Homeowner Child

			Regression Results		
			Dependent variable:		
			log(salesvalue + 1)		
			Normal	SE	HW-Robust SE
			(1)	(2)	
month_dummy9	-0.186 (0.211)	-0.186 (0.233)			
month_dummy10	-0.091 (0.226)	-0.091 (0.239)			
month_dummy11	0.453* (0.217)	0.453 (0.239)			
month_dummy12	1.451*** (0.218)	1.451*** (0.225)	time	0.372* (0.181)	0.372** (0.128)
avg_childownermean	0.764* (0.314)	0.764 (0.605)	group	1.951*** (0.163)	1.951*** (0.130)
time:group	-0.494* (0.207)	-0.494** (0.168)	avg_agemean	-0.192*** (0.031)	-0.192*** (0.047)
Constant	8.366*** (0.418)	8.366*** (0.664)	avg_femalemean	-1.128*** (0.278)	-1.128* (0.478)
Observations	2,005	2,005	avg_incomemean	0.283*** (0.058)	0.283** (0.100)
R2	0.178	0.178	avg_homeownermean	-0.544 (0.295)	-0.544 (0.490)
Adjusted R2	0.170	0.170			
Residual Std. Error	1.969	1.969			
F Statistic	22.580***	22.580***			
Note:	*p<0.05; **p<0.01; ***p<0.001		month_dummy2	0.552* (0.223)	0.552* (0.227)
			month_dummy3	0.168 (0.220)	0.168 (0.224)
			month_dummy4	0.017 (0.222)	0.017 (0.236)
			month_dummy5	0.150 (0.218)	0.150 (0.239)
			month_dummy6	-0.139 (0.222)	-0.139 (0.235)
			month_dummy7	-0.294 (0.218)	-0.294 (0.246)
			month_dummy8	-0.043 (0.204)	-0.043 (0.216)

Model2:

$\ln \text{Sales quantity} =$

$b_0 + b_1 \cdot \text{Time} + b_2 \cdot \text{Group} + b_3 \cdot \text{Time} \cdot \text{Group} + b_4 \cdot \text{Avg_ageband} + b_5 \cdot \text{Avg_female} + b_6 \cdot \text{Avg_income} + b_7 \cdot \text{Avg_homeowner} + b_i \cdot \text{Month_dummy} + b_6 \cdot \text{Child} + e$

$i = 1-12 \text{ months}$

$b_3 = 0.667$

$0.667 - 1 = -0.333 = -33.3\%$

Interpretation: Stores that implement BOPS strategy is associated with 33.3% decrease in sales quantity compared to stores that do not implement BOPS

With BOPS, Sales value ↓ Sales quantity ↓
at store level

month_dummy10	0.849 (0.144)	0.849 (0.135)
month_dummy11	1.444** (0.139)	1.444** (0.132)
month_dummy12	3.249*** (0.139)	3.249*** (0.126)
avg_childownermean	0.896 (0.201)	0.896 (0.228)
avg_homeownermean	0.486*** (0.188)	0.486*** (0.184)
time:group	0.667** (0.133)	0.667** (0.114)
Constant	59.310*** (0.268)	59.310*** (0.256)
Observations	2,005	2,005
Log Likelihood	-13,277.700	-13,277.700
theta	0.636*** (0.017)	0.636*** (0.017)
Akaike Inf. Crit.	26,595.410	26,595.410
Note:	*p<0.05; **p<0.01; ***p<0.001	

Regression Results

	Dependent variable:			
	salesquantity			
	Normal	SE	HW-Robust	SE
	(1)		(2)	
time	1.418** (0.116)		1.418** (0.096)	
group	17.040*** (0.105)		17.040*** (0.100)	
avg_femalemean	0.304*** (0.178)		0.304*** (0.182)	
avg_incomemean	1.323*** (0.037)		1.323*** (0.037)	
avg_agemean	0.838*** (0.020)		0.838*** (0.021)	
month_dummy2	1.309 (0.142)		1.309 (0.134)	
month_dummy3	0.737* (0.141)		0.737* (0.124)	
month_dummy4	0.783 (0.142)		0.783 (0.125)	
month_dummy5	1.174 (0.139)		1.174 (0.129)	
month_dummy6	0.737* (0.142)		0.737* (0.132)	
month_dummy7	0.695** (0.139)		0.695** (0.126)	
month_dummy8	0.824 (0.130)		0.824 (0.123)	
month_dummy9	0.813 (0.134)		0.813 (0.123)	

Q2: What is the impact of implementing BOPS strategy on online channel returns?



	Dependent Variable	Key independent Variable	Control Variable
Model 1	Return value	Times*Group	Sales value (model1) Female Age Income Month Homeowner Child Sales quantity (model2)
Model 2	Return quantity	Times*Group	

Q2 Final Model

Model1:

$$\log(\text{Return value} + 1) = b_0 + b_1 \cdot \text{Time} + b_2 \cdot \text{Group} + b_3 \cdot \text{Time} \cdot \text{Group} + b_4 \cdot \text{Avg_ageband} + b_5 \cdot \text{Avg_female} + b_6 \cdot \text{Avg_income} + b_7 \cdot \text{Avg_homeowner} + b_i \cdot \text{Month_dummy} + b_6 \cdot \text{Child} + b_7 \cdot \log(\text{salesvalue} + 1) + e$$

i= 1-12 months

b3= -0.665

Interpretation: Stores that implement BOPS strategy is associate with 66.5% decrease in return value compared to stores that do not implement BOPS

month_dummy10	-0.520** (0.164)	-0.520*** (0.135)
month_dummy11	-0.591*** (0.158)	-0.591*** (0.132)
month_dummy12	-0.637*** (0.160)	-0.637*** (0.126)
avg_childownermean	0.419 (0.228)	0.419 (0.228)
avg_homeownermean	-0.183 (0.214)	-0.183 (0.184)
time:group	-0.665*** (0.150)	-0.665*** (0.114)
Constant	-5.535*** (0.332)	-5.535*** (0.256)
Observations	2,005	2,005
R2	0.790	0.790
Adjusted R2	0.788	0.788
Residual Std. Error	1.427	1.427
F Statistic	372.433***	372.433***
Note:	*p<0.05; **p<0.01; ***p<0.001	

Regression Results

	Dependent variable:	
	log(returnvalue + 1)	
	Normal SE (1)	HW-Robust SE (2)
time	0.639*** (0.131)	0.639*** (0.096)
group	0.840*** (0.122)	0.840*** (0.100)
avg_ageband	-0.018 (0.022)	-0.018 (0.021)
avg_femaleband	0.564** (0.202)	0.564** (0.182)
avg_incomeband	0.050 (0.042)	0.050 (0.037)
log(salesvalue + 1)	1.241*** (0.016)	1.241
month_dummy2	-0.469** (0.162)	-0.469*** (0.134)
month_dummy3	-0.603*** (0.160)	-0.603*** (0.124)
month_dummy4	-0.571*** (0.161)	-0.571*** (0.125)
month_dummy5	-0.537*** (0.158)	-0.537*** (0.129)
month_dummy6	-0.516** (0.161)	-0.516*** (0.132)
month_dummy7	-0.453** (0.158)	-0.453*** (0.126)
month_dummy8	-0.596*** (0.148)	-0.596*** (0.123)
month_dummy9	-0.354* (0.153)	-0.354** (0.123)

Model2:

$\ln \text{Return quantity} =$

$$b_0 + b_1 \cdot \text{Time} + b_2 \cdot \text{Group} + b_3 \cdot \text{Time} \cdot \text{Group} + b_4 \cdot \text{Avg_ageband} + b_5 \cdot \text{Avg_female} + b_6 \cdot \text{Avg_income} + b_7 \cdot \text{Child} + b_i \cdot \text{Month_dummy} + e$$

$i = 1-12 \text{ months}$

$b_3 = 0.577$

$0.577 - 1 = -0.4223 = -42.23\%$

Interpretation :Stores that implement BOPS strategy is associate with 42.23% decrease in return quantity compared to stores that do not implement BOPS

With BOPS, Return value ↓ Return quantity ↓
at store level

month_dummy9	0.686*** (0.109)	0.686*** (0.123)
month_dummy10	0.762* (0.116)	0.762* (0.135)
month_dummy11	0.778* (0.112)	0.778* (0.132)
month_dummy12	0.949 (0.115)	0.949 (0.126)
avg_agemean	0.881*** (0.017)	0.881*** (0.021)
avg_childownermean	1.257 (0.162)	1.257 (0.228)
time:group	0.577*** (0.113)	0.577*** (0.114)
Constant	3.519*** (0.224)	3.519*** (0.256)
Observations	2,005	2,005
Log Likelihood	-8,118.898	-8,118.898
theta	1.065*** (0.036)	1.065*** (0.036)
Akaike Inf. Crit.	16,277.800	16,277.800
Note:	*p<0.05; **p<0.01; ***p<0.001	


Regression Results

	Dependent variable:	
	returnquantity	
	Normal SE (1)	HW-Robust SE (2)
time	1.567*** (0.101)	1.567*** (0.096)
group	4.718*** (0.093)	4.718*** (0.100)
avg_femalemean	0.788 (0.148)	0.788 (0.182)
avg_incomemean	1.125*** (0.030)	1.125*** (0.037)
salesquantity	1.002*** (0.00002)	1.002***
month_dummy2	0.763* (0.115)	0.763* (0.134)
month_dummy3	0.841 (0.114)	0.841 (0.124)
month_dummy4	0.779* (0.115)	0.779* (0.125)
month_dummy5	0.715** (0.113)	0.715** (0.129)
month_dummy6	0.830 (0.115)	0.830 (0.132)
month_dummy7	0.894 (0.113)	0.894 (0.126)
month_dummy8	0.752** (0.105)	0.752** (0.123)

2) Consumer Level



Q3: What is the impact of using the BOPS service on online customer purchase behavior?



	Dependent variable	Key independent variable	Control variable
Model 1	Sales value	Bops in effect*Bops User	Age Income Homeowner Child Purchase time period
Model 2	Sales quantity	Bops in effect*Bops User	

Q3 Final Model

Model1:

$\log(\text{Sales value}+1) =$

$b_0 + b_1 \cdot \text{Bops_in_effect} + b_2 \cdot \text{Bops_user} + b_3 \cdot \text{Bops_in_effect} \cdot \text{Bops_user} + b_4 \cdot \text{Age_band} + b_5 \cdot \text{Est_income_code} + b_6 \cdot \text{home owner} + b_7 \cdot \text{Child} + b_8 \cdot \text{Purchase_time_period} + e$

$b_3 = -0.0514$

Interpretation: Consumers that uses BOPS is associated with 5.14% decrease per consumer on sales value compare with consumers that not use BOPS

Regression Results

	Dependent variable:	
	log(salesvalue + 1) Normal SE (1)	HW-Robust SE (2)
bops_user	-0.2178*** (0.0121)	-0.2178*** (0.0124)
bops_in_effect	-0.1395*** (0.0076)	-0.1395*** (0.0076)
est_income_codemedian	0.0114*** (0.0016)	0.0114*** (0.0016)
age_bandmedian	0.0054*** (0.0009)	0.0054*** (0.0009)
childdummy	-0.0543*** (0.0071)	-0.0543*** (0.0072)
homeowner_codedummy	-0.0359*** (0.0077)	-0.0359*** (0.0078)
purchase_time_period	0.1054*** (0.0008)	0.1054*** (0.0008)
bops_user:bops_in_effect	-0.0514** (0.0172)	-0.0514** (0.0175)
Constant	5.0890*** (0.0109)	5.0890*** (0.0108)
Observations	84,420	84,420
R2	0.1706	0.1706
Adjusted R2	0.1705	0.1705
Residual Std. Error	0.9761	0.9761
F Statistic	2,169.7480***	2,169.7480***
Note:	*p<0.05; **p<0.01; ***p<0.001	

Model2:

$\ln \text{Sales quantity} = b_0 + b_1 * \text{bops_user} + b_2 * \text{bops_in_effect} + b_3 * \text{bops_user} * \text{bops_in_effect} + b_4 * \text{Est_income_code} + b_5 * \text{Age_band} + b_6 * \text{Child} + b_7 * \text{homeowner} + e$

$b_3 = 0.958$

$0.958 - 1 = -0.042 = -4.2\%$


Interpretation: Consumers that uses BOPS is associated with 4.2% decrease per consumer on sales quantity compare with consumers does not use BOPS

With BOPS, Sales value ↓ Sales quantity ↓ at consumer level

Regression Results

	Dependent variable:	
	salesquantity	
	Normal SE (1)	HW-Robust SE (2)
bops_user	1.029** (0.011)	1.029** (0.023)
bops_in_effect	0.823*** (0.007)	0.823*** (0.021)
est_income_codedmedian	1.013*** (0.001)	1.013*** (0.004)
age_bandmedian	0.999 (0.001)	0.999 (0.002)
childdummy	1.001 (0.006)	1.001 (0.011)
purchase_time_period	1.124*** (0.001)	1.124*** (0.002)
homeowner_codeddummy	0.992 (0.007)	0.992 (0.020)
bops_user:bops_in_effect	0.958** (0.015)	0.958** (0.030)
Constant	1.592*** (0.010)	1.592*** (0.018)
Observations	84,420	84,420
Log Likelihood	-154,622.100	-154,622.100
theta	3.560*** (0.032)	3.560*** (0.032)
Akaike Inf. Crit.	309,262.300	309,262.300
Note:	*p<0.05; **p<0.01; ***p<0.001	

Q4 : What is the impact of using the BOPS service on online customer return behavior?



	Dependent Variable	Key independent Variable	Instrument Variable	Control Variable
Model 1	Return (Dummy, 1 = returned, 0 = not returned)	BOPS (Dummy, 1 = BOPS, 0 = home delivery)	Length of Residence	Price Female Age Income Month Year Store

Q4 Final Model

Model1:

$\log(\text{Sales value}+1) =$
 $b_0 + b_1 * \text{Bops_in_effect} + b_2 * \text{Bops_user} + b_3 * \text{Bops_in_effect} * \text{Bops_user} + b_4 * \text{Age_band} + b_5 * \text{Est_income_code} + b_6 * \text{homeowner} + b_7 * \text{Child} + b_8 * \text{Purchase_time_period} + e$

$b_3 = 0.403$

Interpretation: By having a customer using BOPS increases consumer chance of return by 40% compared to not using BOPS

With BOPS, the chance of consumer return ↑ at consumer level

Regression Results		
	Dependent variable:	
	return	
	Normal SE (1)	HW-Robust SE (2)
bops	0.403*** (0.055)	0.403*** (0.055)
logprice	0.038*** (0.0004)	0.038*** (0.0004)
age_bandmedian	0.0003 (0.0002)	0.0003 (0.0002)
est_income_codemedian	0.002*** (0.0002)	0.002*** (0.0002)
female	0.016*** (0.002)	0.016*** (0.002)
storefactor6	0.032*** (0.006)	0.032*** (0.006)
storefactor5998	-0.154*** (0.027)	-0.154*** (0.024)
monthfactor2	-0.041*** (0.002)	-0.041*** (0.002)
monthfactor3	-0.030*** (0.003)	-0.030*** (0.003)
monthfactor4	-0.020*** (0.002)	-0.020*** (0.002)
monthfactor5	-0.046*** (0.002)	-0.046*** (0.002)
monthfactor6	-0.035*** (0.003)	-0.035*** (0.003)
monthfactor7	-0.045*** (0.003)	-0.045*** (0.003)
monthfactor8	-0.020*** (0.002)	-0.020*** (0.002)
monthfactor9	-0.050*** (0.004)	-0.050*** (0.004)
monthfactor10	-0.047*** (0.004)	-0.047*** (0.004)
monthfactor11	-0.065*** (0.005)	-0.065*** (0.005)
monthfactor12	-0.077*** (0.005)	-0.077*** (0.005)
yearfactor2012	-0.059*** (0.007)	-0.059*** (0.007)
yearfactor2013	-0.065*** (0.008)	-0.065*** (0.008)
Constant	-0.090*** (0.007)	-0.090*** (0.007)
Observations	986,918	986,918
R2	-0.264	-0.264
Adjusted R2	-0.264	-0.264
Residual Std. Error	0.338	0.338
Note:	*p<0.05; **p<0.01; ***p<0.001	


3) Product Level



Q5 : What is the impact of implementing BOPS strategy on product-level sales and returns?

	Dependent Variable	Key independent Variable	Control Variable
Model 1	Sales value	Times*Group	Female Age Income Month_dummy Homeowner Child Product _Category
Model 2	Sales quantity	Times*Group	



	Dependent Variable	Key independent Variable	Control Variable
Model 3	Return value	Times*Group	Salesvalue(Return value) Female Age Income Month_dummy Homeowner Child Product_Category Sales quantity (Return quantity)
Model 4	Return quantity	Times*Group	

Q5 Final Model

	Dependent variable:	
	log(salesvalue + 1)	
	Normal SE (1)	HW-Robust SE (2)
time	0.263*** (0.051)	0.263*** (0.033)
group	1.567*** (0.045)	1.567*** (0.032)
product_category2	-1.191*** (0.061)	-1.191*** (0.061)
product_category3	-0.225*** (0.062)	-0.225*** (0.059)
product_category4	0.137* (0.058)	0.137* (0.059)
product_category5	-0.329*** (0.058)	-0.329*** (0.059)
product_category6	-1.122*** (0.061)	-1.122*** (0.060)
product_category7	-2.836*** (0.065)	-2.836*** (0.062)
product_category8	-2.087*** (0.101)	-2.087*** (0.088)
product_category9	-2.760*** (0.084)	-2.760*** (0.099)
product_category10	-2.892*** (0.151)	-2.892*** (0.122)
product_category11	-0.828*** (0.061)	-0.828*** (0.061)
product_category12	-0.304*** (0.058)	-0.304*** (0.060)
product_category13	-1.235*** (0.062)	-1.235*** (0.058)

product_category14	-2.536*** (0.067)	-2.536*** (0.074)
product_category15	-3.572*** (0.325)	-3.572*** (0.321)
product_category17	0.271** (0.085)	0.271*** (0.065)
product_category20	-0.689*** (0.062)	-0.689*** (0.058)
product_category21	-0.598*** (0.058)	-0.598*** (0.059)
avg_agemean	-0.061*** (0.006)	-0.061*** (0.008)
avg_femalemean	-0.368*** (0.048)	-0.368*** (0.062)
avg_incomemean	0.105*** (0.011)	0.105*** (0.015)
avg_homeownermean	-0.200*** (0.056)	-0.200*** (0.077)
month_dummy2	0.414*** (0.055)	0.414*** (0.058)
month_dummy3	0.045 (0.056)	0.045 (0.060)
month_dummy4	0.011 (0.057)	0.011 (0.059)
month_dummy5	0.229*** (0.055)	0.229*** (0.059)
month_dummy6	-0.0004 (0.057)	-0.0004 (0.057)
month_dummy7	-0.003 (0.056)	-0.003 (0.058)
month_dummy8	0.008 (0.052)	0.008 (0.054)
month_dummy9	0.048	0.048

month_dummy10	0.005 (0.058)	0.005 (0.061)
month_dummy11	0.413*** (0.055)	0.413*** (0.058)
month_dummy12	1.003*** (0.053)	1.003*** (0.056)
avg_childownermean	0.074 (0.052)	0.074 (0.071)
time:group	-0.289*** (0.057)	-0.289*** (0.042)
Constant	7.002*** (0.093)	7.002*** (0.103)
Observations	21,003	21,003
R2	0.323	0.323
Adjusted R2	0.322	0.322
Residual Std. Error	1.608	1.608
F Statistic	277.523***	277.523***
Note:	*p<0.05; **p<0.01; ***p<0.001	

Model1:

log(Sales value+1) =
 $b_0 + b_1 \text{Time} + b_2 \text{Group} + b_3 \text{Time} \times \text{Group} + b_4 \text{Avg_age} + b_5 \text{Avg_female} + b_6 \text{Avg_income} + b_7 \text{Avg_homeowner} + b_1 \text{Month_dummy} + b_6 \text{Child} + b_7 \text{Product_category} + e$

i= 1-12 months

b3= -0.289

Interpretation: Stores that implements BOPS strategy is associated with 28.9% decrease on all product category average sales value compare with stores do not implement BOPS.

Model2:

$\ln \text{Sales quantity} =$
 $b_0 + b_1 \cdot \text{Time} + b_2 \cdot \text{Group} + b_3 \cdot \text{Time} \cdot \text{Group} + b_4 \cdot \text{Avg_ageband} + b_5 \cdot \text{Avg_female} + b_6 \cdot \text{Avg_income} + b_7 \cdot \text{Avg_homeowner} + b_8 \cdot \text{Month_dummy} + b_9 \cdot \text{Child} + b_{10} \cdot \text{Product_category} + e$

$i = 1-12$ months

$b_3 = 0.685$

$0.685 - 1 = -0.315 = -31.5\%$

Regression Results								
Dependent variable:								
salesquantity								
	Normal SE	HW-Robust SE						
	(1)	(2)						
time	1.387*** (0.040)	1.387*** (0.037)	product_category21	6.349*** (0.043)	6.349*** (0.041)	month_dummy11	1.592*** (0.041)	1.592*** (0.047)
group	12.430*** (0.035)	12.430*** (0.034)	avg_femalemean	0.805*** (0.036)	0.805*** (0.034)	month_dummy12	2.939*** (0.039)	2.939*** (0.048)
product_category2	2.088*** (0.046)	2.088*** (0.044)	avg_incomemean	1.230*** (0.009)	1.230*** (0.008)	avg_childownermean	1.043 (0.039)	1.043 (0.032)
product_category3	0.841*** (0.047)	0.841*** (0.039)	avg_agemean	0.876*** (0.005)	0.876*** (0.004)	avg_homeownermean	0.605*** (0.041)	0.605*** (0.033)
product_category4	4.852*** (0.043)	4.852*** (0.041)	month_dummy2	1.526*** (0.041)	1.526*** (0.049)	time:group	0.685*** (0.044)	0.685*** (0.043)
product_category5	6.751*** (0.043)	6.751*** (0.043)	month_dummy3	0.880** (0.042)	0.880** (0.043)	Constant	1.255** (0.070)	1.255** (0.074)
product_category6	1.145** (0.046)	1.145** (0.041)	month_dummy4	0.888** (0.042)	0.888** (0.046)	Observations	21,003	21,003
product_category7	2.935*** (0.048)	2.935*** (0.104)	month_dummy5	1.276*** (0.041)	1.276*** (0.047)	Log Likelihood	-87,047.710	-87,047.710
product_category8	0.170*** (0.081)	0.170*** (0.060)	month_dummy6	0.849*** (0.043)	0.849*** (0.042)	theta	0.739*** (0.007)	0.739*** (0.007)
product_category9	3.495*** (0.062)	3.495*** (0.078)	month_dummy7	0.820*** (0.042)	0.820*** (0.041)	Akaike Inf. Crit.	174,169.400	174,169.400
			month_dummy8	0.927* (0.039)	0.927* (0.048)	Note:	*p<0.05; **p<0.01; ***p<0.001	
			month_dummy9	0.906* (0.040)	0.906* (0.041)			

Interpretation: Stores s that implement BOPS strategy is associated with 31.5% decrease on average sales quantity on all product category compare with stores do

Interpretation: Stores that implement BOPS strategy is associated with 31.5% decrease on average sales quantity on all product category compare with stores do not implement BOPS.

With BOPS, Sales value ↓ Sales quantity ↓
 at product level



Model1:

$$\log(\text{Return value}+1) = b_0+b_1*\text{Time}+b_2*\text{Group}+b_3*\text{Time}*\text{Group}+b_4*\text{Avg_ageband}+b_5*\text{Avg_female}+b_6*\text{Avg_income}+b_7*\text{Avg_homeowner}+b_1*\text{Month_dummy}+b_6*\text{Child}+b_7*\log(\text{salesvalue}+1)+b_8*\text{Product_category}+e$$

i= 1-12 months

b3= -0.326

Interpretation: Stores that implement BOPS strategy is associated with 32.6% decrease on all product category average return value compared to stores that do not implement BOPS.

Regression Results									
Dependent variable:									
log(returnvalue + 1)									
Normal SE		HW-Robust SE							
(1)		(2)							
				product_category20	0.636*** (0.085)	0.636*** (0.097)	month_dummy9	-0.531*** (0.074)	-0.531*** (0.074)
				product_category21	0.575*** (0.080)	0.575*** (0.087)	month_dummy10	-0.400*** (0.079)	-0.400*** (0.079)
time	0.233*** (0.070)	0.233** (0.077)		avg_agemean	-0.056*** (0.009)	-0.056*** (0.010)			
group	1.274*** (0.064)	1.274*** (0.070)		avg_femalemean	0.386*** (0.066)	0.386*** (0.076)	month_dummy11	-0.389*** (0.076)	-0.389*** (0.074)
log(salesvalue + 1)	1.348*** (0.010)	1.348*** (0.012)		avg_incomemean	0.048** (0.016)	0.048** (0.018)	month_dummy12	-0.545*** (0.074)	-0.545*** (0.073)
product_category2	1.131*** (0.085)	1.131*** (0.091)		avg_homeownermean	-0.076 (0.077)	-0.076 (0.089)			
product_category3	0.042 (0.085)	0.042 (0.103)		month_dummy2	-0.457*** (0.076)	-0.457*** (0.076)	avg_childownermean	-0.084 (0.072)	-0.084 (0.084)
product_category4	0.672*** (0.079)	0.672*** (0.089)		month_dummy3	-0.427*** (0.077)	-0.427*** (0.079)	time:group	-0.326*** (0.078)	-0.326*** (0.083)
product_category5	0.585*** (0.080)	0.585*** (0.087)		month_dummy4	-0.491*** (0.078)	-0.491*** (0.078)	Constant	-7.279*** (0.144)	-7.279*** (0.166)
product_category6	0.660*** (0.085)	0.660*** (0.095)		month_dummy5	-0.500*** (0.076)	-0.500*** (0.077)			
product_category7	0.596*** (0.093)	0.596*** (0.099)		month_dummy6	-0.535*** (0.078)	-0.535*** (0.078)			
product_category8	0.427** (0.140)	0.427* (0.173)					Observations	21,003	21,003
							R2	0.604	0.604
							Adjusted R2	0.603	0.603
							Residual Std. Error	2.218	2.218
							F Statistic	864.190***	864.190***
							Note:	*p<0.05; **p<0.01; ***p<0.001	



Model2:

InReturn quantity =
b0+b1*Time+b2*Group+b3*Time
Group+b4*Avg_ageband+b5*Avg_
female+b6*Avg_income+b7*Child
+bi*Month_dummy+b8*Product_
ategory+e

i= 1-12 months

b3= 0.620

0.620-1 = -0.38 =-38%


Interpretation: Stores that implement BOPS strategy
is associated with 38% decrease on average return
quantity on all product category compare with stores
that do not implement BOPS.


With BOPS, Return value ↓ Return quantity ↓
at product level

Regression Results								
Dependent variable: avg_femalemean				1.096*	1.096*	month_dummy12	1.077	1.077
				(0.039)	(0.031)		(0.043)	(0.039)
returnquantity								
Normal SE		HW-Robust		avg_incomemean	1.103***	1.103***		
(1)	(2)	(1)	(2)	(0.009)	(0.008)			
time	1.511***	1.511***	avg_agemean	0.923***	0.923***	avg_childownermean	0.967	0.967
	(0.058)	(0.059)	(0.005)	(0.004)		(0.043)	(0.033)	
group	6.107***	6.107***	month_dummy2	0.903*	0.903*	avg_homeownermean	0.780***	0.780***
	(0.051)	(0.050)	(0.045)	(0.039)		(0.046)	(0.036)	
product_category2	1.278***	1.278***	month_dummy3	0.879**	0.879**			
	(0.047)	(0.042)	(0.045)	(0.040)				
product_category3	0.837***	0.837***	month_dummy4	0.790***	0.790***	salesquantity	1.008***	1.008***
	(0.049)	(0.044)	(0.046)	(0.040)		(0.0001)	(0.0001)	
product_category4	1.238***	1.238***	month_dummy5	0.849***	0.849***	time:group	0.620***	0.620***
	(0.045)	(0.039)	(0.045)	(0.040)		(0.061)	(0.062)	
product_category5	0.900*	0.900*	month_dummy6	0.840***	0.840***			
	(0.046)	(0.042)	(0.047)	(0.047)				
product_category6	0.879**	0.879**	month_dummy7	0.916	0.916	Constant	0.493***	0.493***
	(0.048)	(0.044)	(0.074)	(0.046)	(0.048)		(0.083)	(0.075)
product_category7	0.184***	0.184***	month_dummy8	0.822***	0.822***			
	(0.066)	(0.066)	(0.083)	(0.042)	(0.038)			
product_category8	0.252***	0.252***						
	(0.097)	(0.083)						
Observations				21,003	21,003			
Log Likelihood				-43,102.720	-43,102.720			
theta				0.905*** (0.014)	0.905*** (0.014)			
Akaike Inf. Crit.				86,281.450	86,281.450			
Note:				*p<0.05; **p<0.01; ***p<0.001				

Interpretation: Stores that implement BOPS strategy are associated with 38% decrease on average return quantity on all product category compare with stores that do not implement BOPS

Q6 : How does the impact of implementing BOPS strategy vary across product categories?

	Dependent Variable	Key independent Variable	Control Variable
Model 1	Sales value	Times*Group*Product_Category	Female Age Income Month_dummy Homeowner
Model 2	Return value	Times*Group*Product_Category	Child Sales value(Return value)

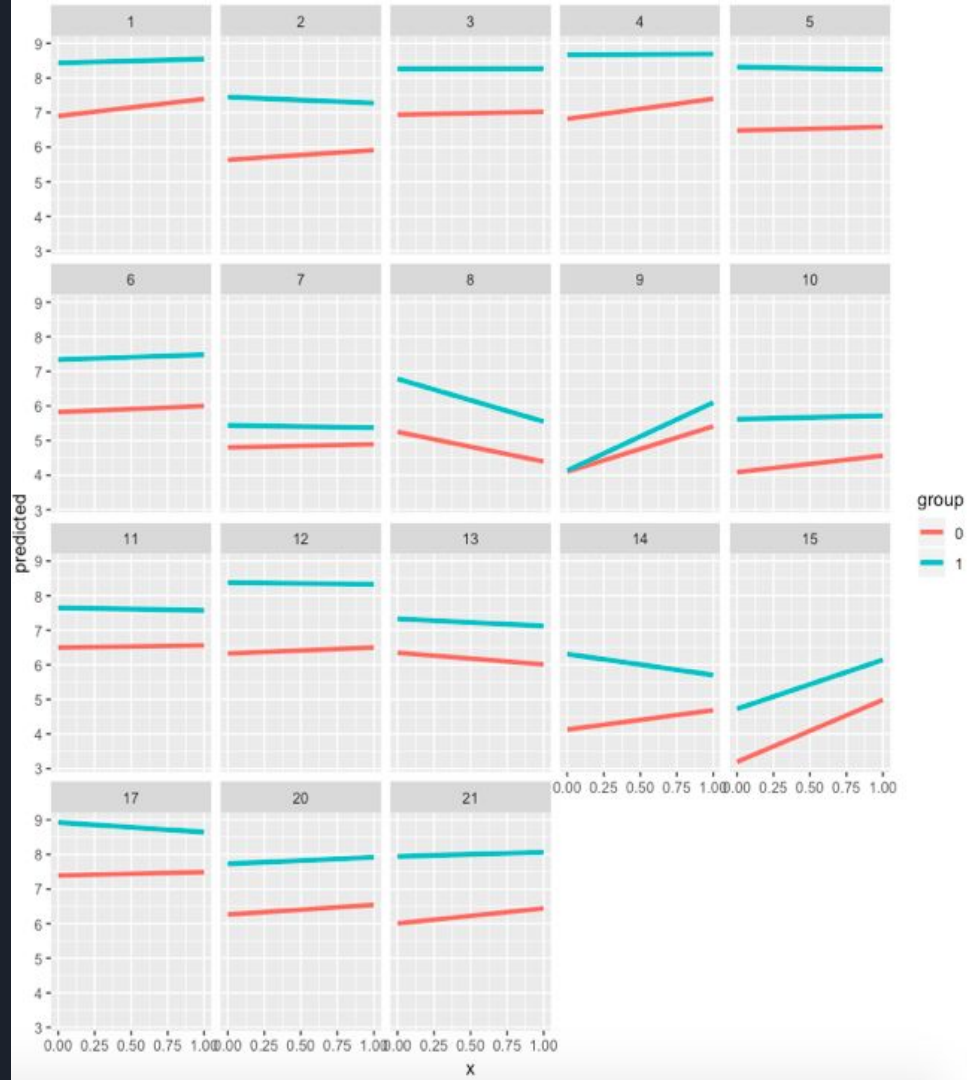


Since the coefficient of triple interaction is unable to interpret, therefore we generate marginal effect of each product category and build model to find the impact of each category.

Marginal Effects of Sales Value

Theoretical model:

$\text{Log}(\text{Sale value}) =$
 $\text{time} * \text{group} * \text{product_category} + \text{age} + \text{female}$
 $+ \text{income} + \text{homeowner} + \text{month} + \text{child}$





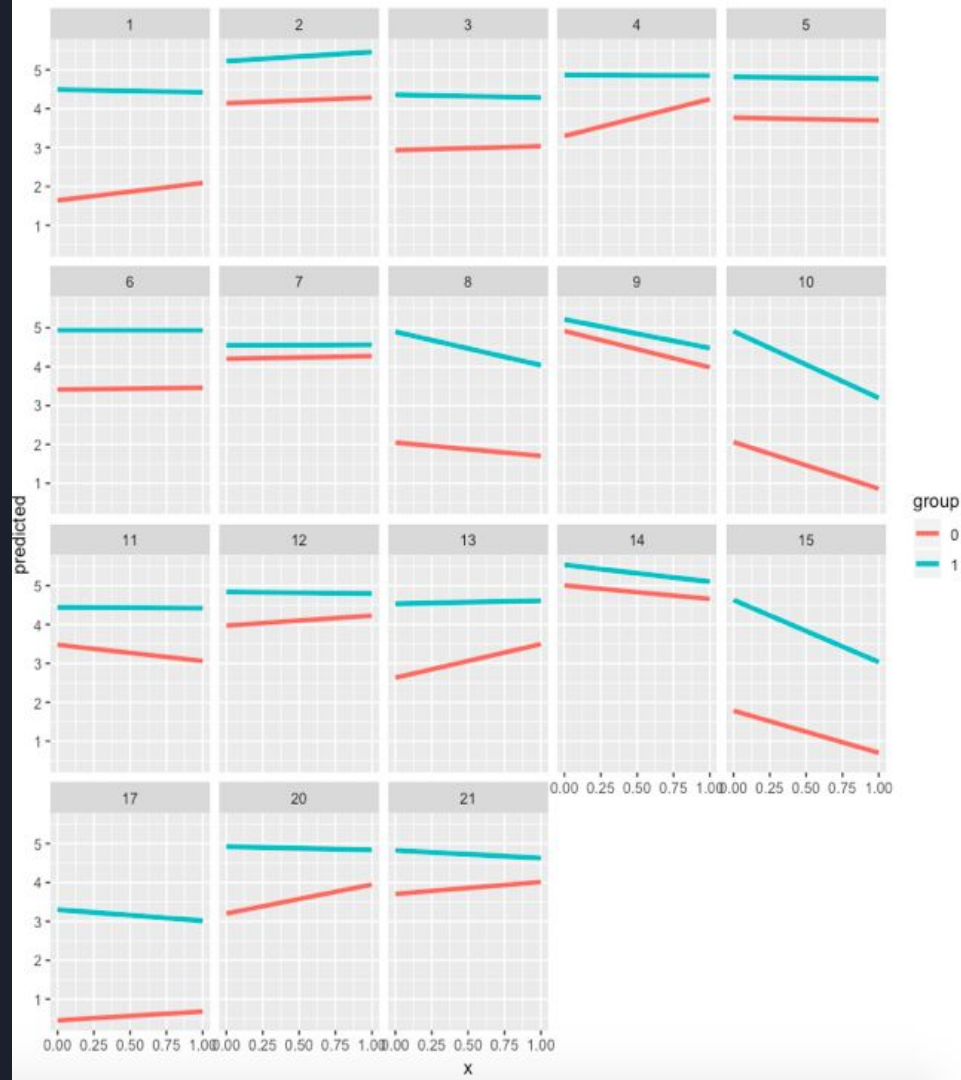
Impact on sales value on each category


Category	Impact after adopting BOPS
1-Bridal	-31.3%
4-Diamond Fashion	-62%
2-Gold Wed Bands	-38.8%
20-Diamond Wedding Band	-39.3%
21-Sterling Silver	-114%

Marginal Effects of Return Value

Theoretical model:

$\text{Log}(\text{Return value}) = \text{time} * \text{group} * \text{product_category} + \text{age} + \text{female} + \text{income} + \text{homeowner} + \text{month} + \text{child} + \text{log}(\text{sale value})$





Impact on return value on each category

Category	Impact after adopting BOPS
4-Diamond Fashion	-94.1%
13-Watches	-80.2%
20-Diamond Wedding Band	-92%
21-Sterling Silver	-52.4%



Conclusion

Impact of implementing BOPS

	Sales	Return
Store Level	Quantity ↓	Quantity ↓
	Value ↓	Value ↓
Consumer Level	Value ↓	Chance of consumer return ↑
	Quantity ↓	
Product Level	Value ↓	Value ↓
	Quantity ↓	Quantity ↓



Conclusion

After implementing the BOPS strategy, jewelry stores would sell less items and the items sold are at a lower price point. The number of items returned would decrease and items returned are at a lower price point.

With BOPS, consumers would purchase less items and less expensive items. The chance of consumer return would increase.

The average impact of implementing BOPS on product level sales and return is consistent with the store level. For higher price point categories such as, bridal, diamond fashion, gold and diamond wedding bands, and sterling silver, less expensive items were sold. The items returned in these categories and in the watch category are at a lower price point.



Conclusion & Limitation

Overall, it seems that implementing BOPS strategy would have a negative impact on online sales and a positive impact on online return value and quantity, but a negative impact on consumer chance of return. BOPS have a negative impact on the sales and return value on some higher price point categories such as, bridal, diamond fashion, gold and diamond wedding bands, and sterling silver.

We need to look at the overall effect of BOPS on sales and returns on both online and in-store channels to determine whether BOPS is the right strategy for the company. Many other factors go into returns such as product quality, basket size in similar product category, salesperson's knowledge, and consumer expectation, we will need these variables to isolate the effect of BOPS on return.

Q&A

