Final Project

Salesperson Training in retail Stores Project

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Outline

- ✔ *Intro & Data Summary*
- ✔ *Theoretical & Final Models*
- ✔ *Results Interpretation*
- ✔ *Managerial suggestion*

- *Impact of salesperson training on sales?*
- *Impact of salesperson training on consumer returns?*
- *customer perceive trained salesperson more competent?*

Data Snapshot

	customer_id	purchase_date	transaction_id	store_number	net_purchase_amount	sku	sales_assoc_1	return	return_date
1	34932428	19NOV2012:00:00:00	440762	160	25.00	18813972	1397	0	
2	308411004351	03AUG2012:00:00:00	435908	160	88.50	18151647	1397	0	
3	25200048	25OCT2012:00:00:00	439669	160	49.99	17485939	1397	0	
4	308420508244	27DEC2011:00:00:00	424684	160	89.00	18151621	1397	0	
5	31069863	24DEC2011:00:00:00	424507	160	299.99	18223370	1397	0	
6	29482301	02FEB2012:00:00:00	426730	160	141.75	18096594	1397	0	
7	22878944	10NOV2012:00:00:00	440363	160	199.00	44777225	1397	0	
8	32930267	03MAY2012:00:00:00	431322	160	19.99	18964882	1397	0	
9	335630000360	05OCT2012:00:00:00	438799	160	79.96	19317593	1397	0	
10	313200000017	14FEB2012:00:00:00	427522	160	35.00	18634063	1397	0	
11	313200000017	14FEB2012:00:00:00	427522	160	30.00	18633180	1397	0	
12	29969200	17OCT2011:00:00:00	420443	160	23.99	17093998	1397	0	
13	30854436	15DEC2011:00:00:00	423706	160	303.75	18097543	1397	0	
14	308431229578	22AUG2011:00:00:00	417687	160	515.40	17736323	1397	0	

Showing 1 to 15 of 2,174,437 entries

6 datasets, 2,174,437 transactions, 60 + Variables

Data processing…

- ***Net-purchase-amount includes return amount***
  - *Exclude return amount from sales amount*
- ***Data inconsistency***
  - *Fiscal Year & Natural Year*
  - *Salesperson service of year*
- ***N/A solution***
  - *Treat as something meaningful*
  - *Treat as 0*
  - *Just ignore*

	customer_id	transaction_id	store_number	net_purchase_amount	sku	sales_assoc_1	return	return_date	return_store	time_to_return	gender	age_band	est_income_code	ethr
94562	2.432578e+07	85156	201	447.52	11906146	22799	0		NA	NA		0	NA	H
522976	2.373603e+06	803476	91	269.10	12094991	439495	0		NA	NA	F	7	5	H
1388987	2.722495e+06	407149	234	254.15	12094991	1027632	0		NA	NA	M	0	3	H
1778526	2.727748e+06	395377	234	201.69	12094991	1037417	1	31MAY2012:00:00:00	234	19		0	1	N
1807266	1.815341e+07	386317	226	269.10	12094991	1038147	0		NA	NA	U	0	5	S
520990	2.169022e+07	91543	12	269.10	12094991	434899	1	29JUN2013:00:00:00	12	16	M	0	6	H
137885	2.252558e+07	554314	163	299.00	12094991	32664	0		NA	NA	U	0	4	X
1548909	2.287684e+07	121166	69	299.00	12094991	1030734	1	24FEB2014:00:00:00	69	0	M	0	4	N
1243902	2.432299e+07	2039548	13	269.10	12094991	1009318	0		NA	NA	F	5	7	N
104065	2.439109e+07	549800	145	249.00	12094991	25060	0		NA	NA		0	1	H
1113883	2.559150e+07	388760	193	249.00	12094991	989822	1	01OCT2010:00:00:00	193	1	F	12	9	N
108680	2.576585e+07	52267	14	199.00	12094991	26238	0		NA	NA	M	10	6	N
1146731	2.593596e+07	402357	160	249.00	12094991	995906	0		NA	NA	F	5	1	N
1126659	2.593610e+07	408552	175	249.00	12094991	991250	0		NA	NA	F	10	6	G
418979	2.675719e+07	268666	92	249.00	12094991	134310	1	09JAN2011:00:00:00	92	17	M	6	1	G
233965	2.747526e+07	452653	167	269.10	12094991	61356	0		NA	NA	M	9	1	H
293549	2.783083e+07	468680	219	249.00	12094991	89028	0		NA	NA	F	9	5	S
510040	2.802508e+07	1035651	13	249.00	12094991	414932	0		NA	NA	F	13	6	N
449118	2.802790e+07	411154	160	236.55	12094991	302032	0		NA	NA	F	0	1	H
187615	2.811086e+07	564815	163	299.00	12094991	45607	0		NA	NA	F	0	4	H
120936	2.815316e+07	642736	142	249.00	12094991	28118	0		NA	NA	M	7	2	F
411325	2.836690e+07	505841	180	249.00	12094991	132341	0		NA	NA		NA	NA	
1054102	2.906884e+07	352721	49	249.00	12094991	981272	1	02AUG2011:00:00:00	49	20	M	12	6	N
499107	2.907070e+07	424400	175	249.00	12094991	389949	0		NA	NA	M	13	6	N
1341419	2.920268e+07	2023971	13	249.00	12094991	1021711	0		NA	NA	F	0	6	N

Showing 1 to 26 of 2,174,437 entries

Data processing…

- ***Net-purchase-amount includes return amount***
  - *Exclude return amount from sales amount*
- ***Data inconsistency***
  - *Fiscal Year & Natural Year*
  - *Salesperson service of year*
- ***N/A solution***
  - *Treat as something meaningful*
  - *Treat as 0*
  - *Just ignore*

ase_amount	sales_assoc_1	return	gender	age_band	ethnic_code	child	month	month_index	SA_gender	SA_YearsofService	SA_MartialStatus	SA_RateofPay	SA_
35.000000	2225	0		0	I	N	DEC	17	F	31	S	1736.93	
18.490000	2225	0	M	8	S	Y	DEC	17	F	31	S	1736.93	
17.990000	2225	0	F	3	N	N	AUG	13	F	31	S	1736.93	
30.980000	2225	0	F	9	U	Y	AUG	13	F	31	S	1736.93	
36.980000	2225	0		0	U	N	DEC	17	F	31	S	1736.93	
0.000000	2225	0		NA			AUG	13	F	31	S	1736.93	
14.990000	2225	0	M	12	N	N	AUG	13	F	31	S	1736.93	
1.000000	2243	0		NA			FEB	19	F	15	M	17.15	Ye
20.980000	2243	0		NA			DEC	17	F	15	M	17.15	Ye
1.000000	2243	0		NA			JUN	35	F	16	M	17.15	Ye
20.490000	2243	0		NA			FEB	19	F	15	M	17.15	Ye
39.980000	2243	0		NA			FEB	19	F	15	M	17.15	Ye
1.000000	2243	0		NA			FEB	19	F	15	M	17.15	Ye
13.980000	2243	0		NA			FEB	19	F	15	M	17.15	Ye
1.000000	2243	0		NA			FEB	19	F	15	M	17.15	Ye
1.000000	2243	0		NA			FEB	19	F	15	M	17.15	Ye
28.980000	2243	0		NA			JUN	35	F	16	M	17.15	Ye
13.980000	2243	0		NA			FEB	19	F	15	M	17.15	Ye
29.990000	2243	0		NA			DEC	17	F	15	M	17.15	Ye

Data processing…

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	Store #	State	Status	EID	Job Name	Category	Start Date	Rehire	Warranty	Credit	Spec. Ev.	training2012
145	193	WA	Active	1009224	Jewelry Consultant	FT-Reg	2010-11-05	2010-11-05	Yes	Yes	Yes	1
146	193	WA	Active	1037343	SM	FT-Reg	2012-04-30	2012-04-30	Yes	Yes	Yes	1
147	193	WA	Active	1036337	Jewelry Consultant	PT-Reg	2012-02-23	2012-02-23	Yes	Yes	Yes	1
148	193	WA	Active	1037905	Jewelry Consultant	PT-Reg	2012-06-01	2012-06-01	No	Yes	Yes	1
149	193	WA	Active	496810	Jewelry Consultant	FT-Reg	2007-01-29	2010-10-12	Yes	Yes	Yes	1
150	193	WA	Active	1024206	Jewelry Consultant	FT-Reg	2011-01-24	2011-01-24	Yes	Yes	Yes	1
151	201	PR	Active	22799	SM	FT-Reg	2000-06-06	2000-06-06	Yes	Yes	N/A	1
152	201	PR	Active	803298	Jewelry Consultant	PT-Reg	2008-05-07	2008-05-07	Yes	Yes	N/A	1
153	201	PR	Active	1035418	Jewelry Consultant	PT-Reg	2011-12-07	2012-02-08	Yes	Yes	N/A	1
154	201	PR	Active	431902	Jewelry Consultant	FT-Reg	2006-07-08	2010-10-25	Yes	Yes	N/A	1
155	201	PR	Active	130690	Jewelry Consultant	FT-Reg	2004-05-14	2009-09-18	Yes	Yes	N/A	1
156	204	IA	Active	1036392	Jewelry Consultant	FT-Reg	2012-02-27	2012-02-27	Yes	Yes	Yes	1
157	204	IA	Active	54788	SM	FT-Reg	1981-12-03	1981-12-03	Yes	Yes	Yes	1
158	204	IA	Active	851709	Jewelry Consultant	FT-Reg	2009-02-16	2009-02-16	Yes	Yes	Yes	1
159	204	IA	Active	1038793	Jewelry Consultant	PT-Reg	2012-07-23	2012-07-23	Yes	Yes	No	1
160	204	IA	Active	121763	Jewelry Consultant	FT-Reg	1987-05-04	1987-05-04	Yes	Yes	Yes	1
161	212	PA	Active	1037703	Jewelry Consultant	FT-Reg	2012-05-21	2012-05-21	Yes	Yes	Yes	1
162	212	PA	Active	109814	Jewelry Consultant	FT-Reg	2000-09-25	2000-09-25	Yes	Yes	Yes	1
163	212	PA	Active	1032481	Jewelry Consultant	PT-Reg	2011-11-09	2011-11-09	Yes	Yes	Yes	1

Data processing…

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  - *Just ignore*

Question 1:
Effect of Training on Sales

Variables of 2012 Theoretical Model

Dependent Variable

- ***NPA2012*** *= net purchase amount in 2012 sold by sales associate i*

Key Independent Variable

- ***NumTrain12*** *= categorical variable between 0 and 3 for how many training modules were taken by sales associate i*

Other Variables of Interest

- ***NPA2011*** *= net purchase amount in 2011 sold by sales associate i*
- ***Sales Associate demographics: SA_Full, SA_Temp, SA_YearsofService, XPdummy12, SA_gender, SA_RateofPay***
- ***Customer demographics: Cgenderdummy, age_band, est_income_code***

2012 Theoretical Model

- ✔ *Linear Model*

$$logNPA2012_i = \beta_0 + \beta_1 logNPA2011_i + \beta_2 NumTrain12_i + \beta_3 SA\_Full_i + \beta_4 SA\_Temp_i + \beta_5 SA\_YearsofService_i + \beta_6 SA\_gender_i + \beta_7 logSA\_RateofPay_i + \beta_8 Cgenderdummy_i + \beta_9 age\_band_i + \beta_{10} est\_income\_code_i + \varepsilon_i$$

Final 2012 Model

$$logNPA2012_i = 6 + 0.2\ logNPA2011_i + 2\ NumTrain12_i -$$
$$0.4\ (NumTrain12_i)^2 + 0.2\ SA\_Full_i - 0.6\ SA\_Temp_i -$$
$$0.03\ SA\_YearsofService_i + 1.3\ Cgenderdummy_i + 0.05\ age\_band_i -$$
$$0.07\ est\_income\_code_i + 0.2\ NumTrain12_i{*}SA\_Full_i$$

Final 2012 Model

```
Call:
lm(formula = logNPA2012 ~ logNPA2011 + NumTrain12 + I(NumTrain12^2) +
    SA_Full + SA_Temp + SA_YearsofService + Cgenderdummy + age_band +
    est_income_code + NumTrain12:SA_Full, data = workingdata2012)

Residuals:
    Min      1Q  Median      3Q     Max
-6.8743 -1.7983  0.0903  1.8261  4.8665

Coefficients:
                  Estimate Std. Error t value Pr(>|t|)
(Intercept)        5.98247    0.18760  31.890  < 2e-16 ***
logNPA2011         0.21392    0.01150  18.605  < 2e-16 ***
NumTrain12         1.99223    0.59779   3.333 0.000872 ***
I(NumTrain12^2)   -0.39036    0.20212  -1.931 0.053544 .
SA_Full            0.22257    0.10332   2.154 0.031308 *
SA_Temp           -0.62690    0.13497  -4.645 3.57e-06 ***
SA_YearsofService -0.03436    0.01243  -2.764 0.005751 **
Cgenderdummy       1.30540    0.19419   6.722 2.18e-11 ***
age_band           0.04938    0.01844   2.678 0.007450 **
est_income_code   -0.07297    0.03376  -2.161 0.030774 *
NumTrain12:SA_Full 0.21594    0.12955   1.667 0.095677 .
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 2.248 on 2681 degrees of freedom
Multiple R-squared:  0.299,     Adjusted R-squared:  0.2964
F-statistic: 114.4 on 10 and 2681 DF,  p-value: < 2.2e-16
```

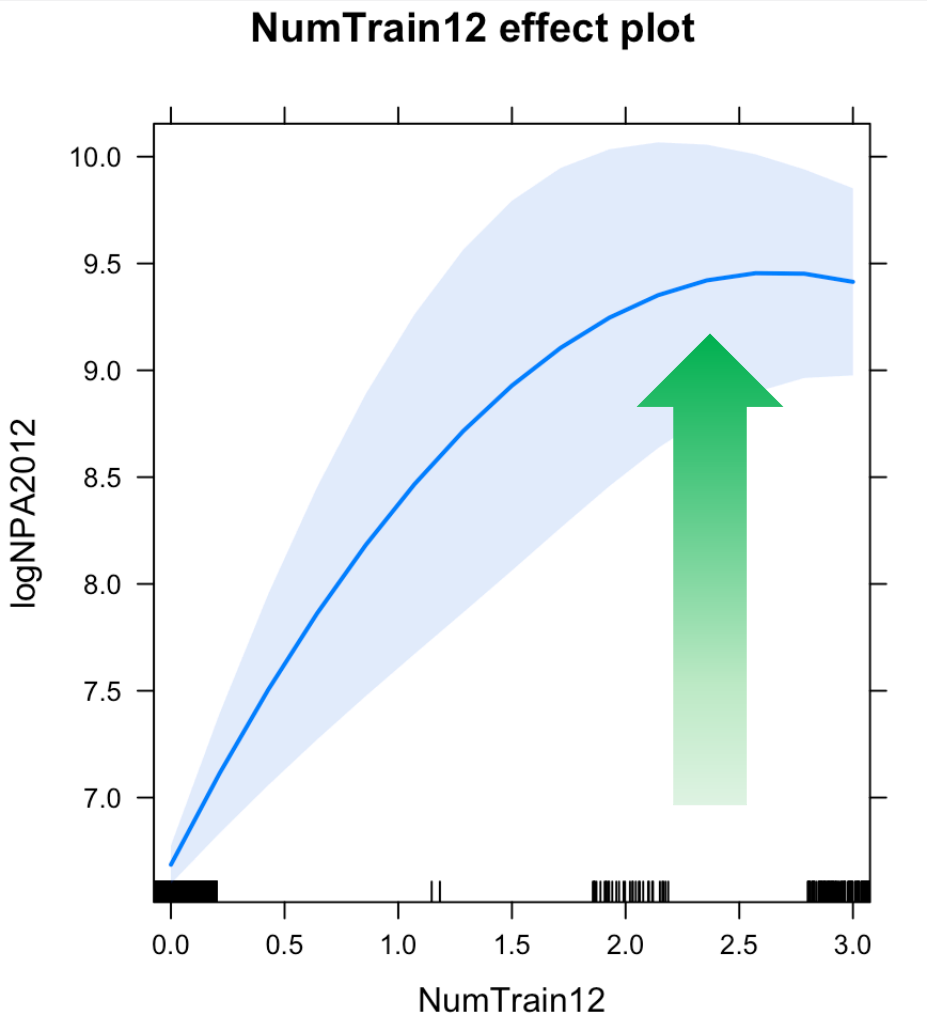
```
t test of coefficients:

                   Estimate Std. Error t value  Pr(>|t|)
(Intercept)        5.982466   0.199518 29.9845 < 2.2e-16 ***
logNPA2011         0.213920   0.010881 19.6595 < 2.2e-16 ***
NumTrain12         1.992227   0.357562  5.5717 2.774e-08 ***
I(NumTrain12^2)   -0.390361   0.118126 -3.3046 0.0009636 ***
SA_Full            0.222572   0.110777  2.0092 0.0446163 *
SA_Temp           -0.626899   0.114102 -5.4942 4.294e-08 ***
SA_YearsofService -0.034361   0.011924 -2.8816 0.0039882 **
Cgenderdummy       1.305397   0.222050  5.8788 4.644e-09 ***
age_band           0.049376   0.019080  2.5879 0.0097089 **
est_income_code   -0.072966   0.036011 -2.0262 0.0428382 *
NumTrain12:SA_Full 0.215938   0.085006  2.5403 0.0111332 *
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

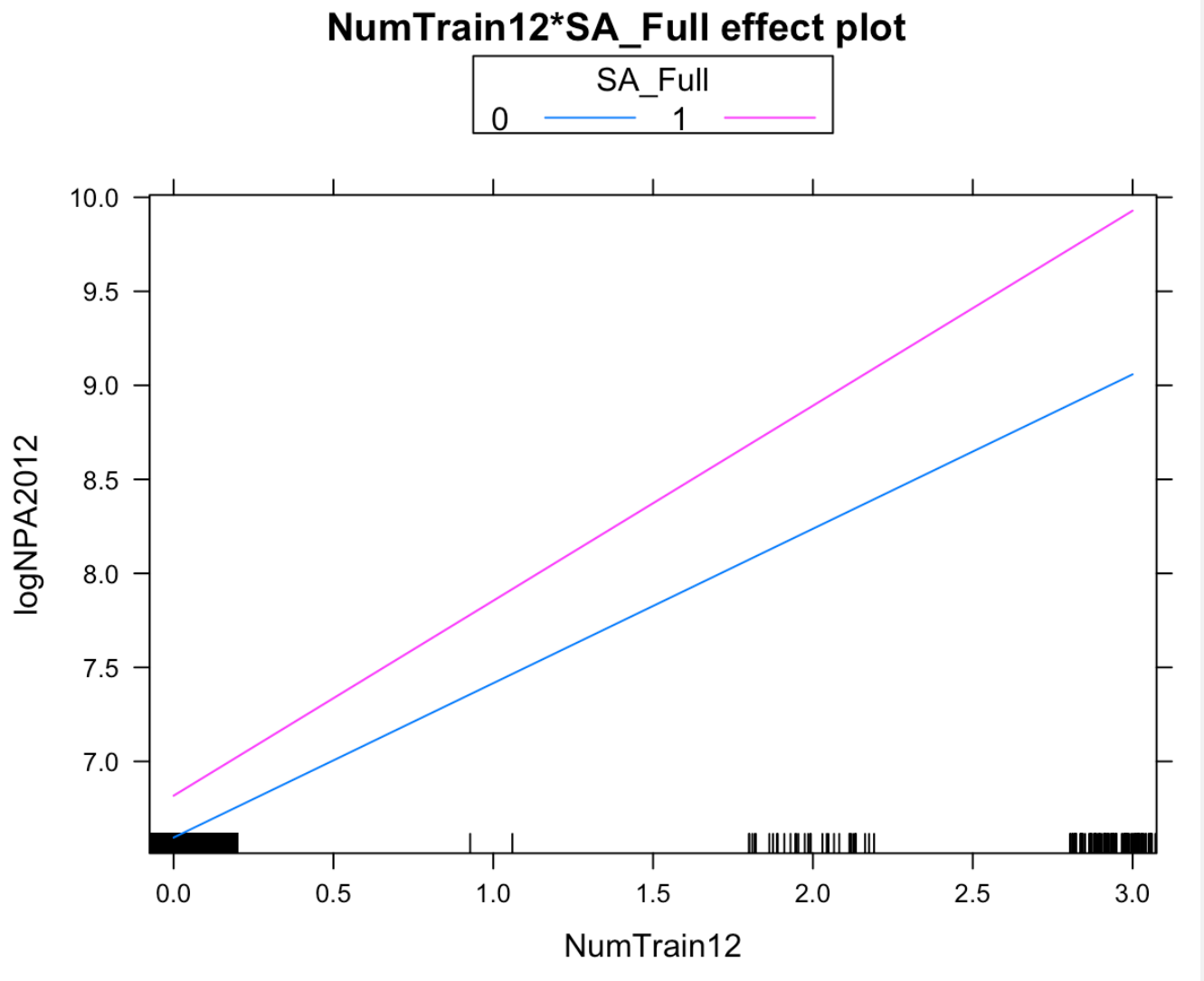
Interpretation of individual variables

Variables	β	*Result*
NPA2011	0.2	For each 1% increase in sales the year before, employee sales increase by roughly 20%
SA_Full	0.2	Employee sales are roughly 20% higher for full-time employees
SA_Temp	-0.6	Employee sales are roughly 60% lower for temporary employees
SA_YearsofService	-0.03	For each additional year of employment, employee sales decrease by roughly 3%
Cgenderdummy	1.3	Employee sales are roughly 130% higher with female customers
age_band	0.05	For each 1 unit increase in customer age group, employee sales increase by roughly 5%
est_income_code	-0.1	For each 1 unit increase in customer income level, employee sales decrease by roughly 10%

Effect of Training on Sales



Interpretation of interaction term



Variables of 2013 Theoretical Model

Dependent Variable

- ***NPA2013*** *= net purchase amount in 2013 sold by sales associate i*

Key Independent Variable

- ***NumTrain13*** *= categorical variable between 0 and 3 for how many training modules were taken by sales associate i*

Other Variables of Interest

- ***NPA2012*** *= net purchase amount in 2012 sold by sales associate i*
- ***Sales Associate demographics: SA_Full, SA_Temp, SA_YearsofService, XPdummy13, SA_gender, SA_RateofPay***
- ***Customer demographics: Cgenderdummy, age_band, est_income_code***

2013 Theoretical Model

- ✔ *Linear Model*

$$
\begin{aligned}
&logNPA2013_i \\
&= \beta_0 + \beta_1 logNPA2012_i + \beta_2 NumTrain12_i + \beta_3 NumTrain13_i \\
&+ \beta_4 SA\_Full_i + \beta_5 SA\_Temp_i + \beta_6 SA\_YearsofService_i + \beta_7 SA\_gender_i \\
&+ \beta_8 logSA\_RateofPay_i + \beta_9 Cgenderdummy_i + \beta_{10} age\_band_i \\
&+ \beta_{11} est\_income\_code_i + \varepsilon_i
\end{aligned}
$$

Final 2013 Model

$$
\begin{aligned}
&logNPA2013_i \\
&= 5.6 + 0.3\ logNPA2012_i + 0.3\ NumTrain12_i + 1.2\ NumTrain13_i \\
&- 0.09\ (NumTrain13_i)^2 + 0.08\ SA\_Full_i - 0.1\ SA\_Temp_i \\
&- 0.1\ SA\_YearsofService_i + 0.9\ Cgenderdummy_i - 0.1\ age\_band_i \\
&- 0.04\ est\_income\_code_i - 0.1\ NumTrain12_i{*}NumTrain13_i \\
&- 0.01\ NumTrain12_i{*}SA\_YearsofService_i
\end{aligned}
$$

Final 2013 Model

```
> summary(model13_7)

Call:
lm(formula = logNPA2013 ~ logNPA2012 + NumTrain12 + NumTrain13 +
    I(NumTrain13^2) + SA_Full + SA_Temp + SA_YearsofService +
    Cgenderdummy + age_band + est_income_code + NumTrain12:NumTrain13 +
    SA_YearsofService:NumTrain13, data = workingdata2013)

Residuals:
    Min      1Q  Median      3Q     Max
-8.4029 -1.6683  0.0504  1.6327  5.9793

Coefficients:
                            Estimate Std. Error t value Pr(>|t|)
(Intercept)                 5.570335   0.201536  27.639  < 2e-16 ***
logNPA2012                  0.272941   0.011184  24.405  < 2e-16 ***
NumTrain12                  0.329699   0.103188   3.195  0.00141 **
NumTrain13                  1.243741   0.186296   6.676 2.95e-11 ***
I(NumTrain13^2)            -0.091890   0.025775  -3.565  0.00037 ***
SA_Full                     0.079980   0.093781   0.853  0.39382
SA_Temp                    -0.135654   0.126876  -1.069  0.28508
SA_YearsofService          -0.072768   0.012415  -5.862 5.13e-09 ***
Cgenderdummy                0.920094   0.187136   4.917 9.32e-07 ***
age_band                   -0.066615   0.020555  -3.241  0.00121 **
est_income_code             0.038791   0.032841   1.181  0.23763
NumTrain12:NumTrain13      -0.099705   0.021639  -4.608 4.26e-06 ***
NumTrain13:SA_YearsofService  0.007151   0.003773   1.895  0.05815 .
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 2.112 on 2765 degrees of freedom
Multiple R-squared:  0.3923,    Adjusted R-squared:  0.3897
F-statistic: 148.8 on 12 and 2765 DF,  p-value: < 2.2e-16
```

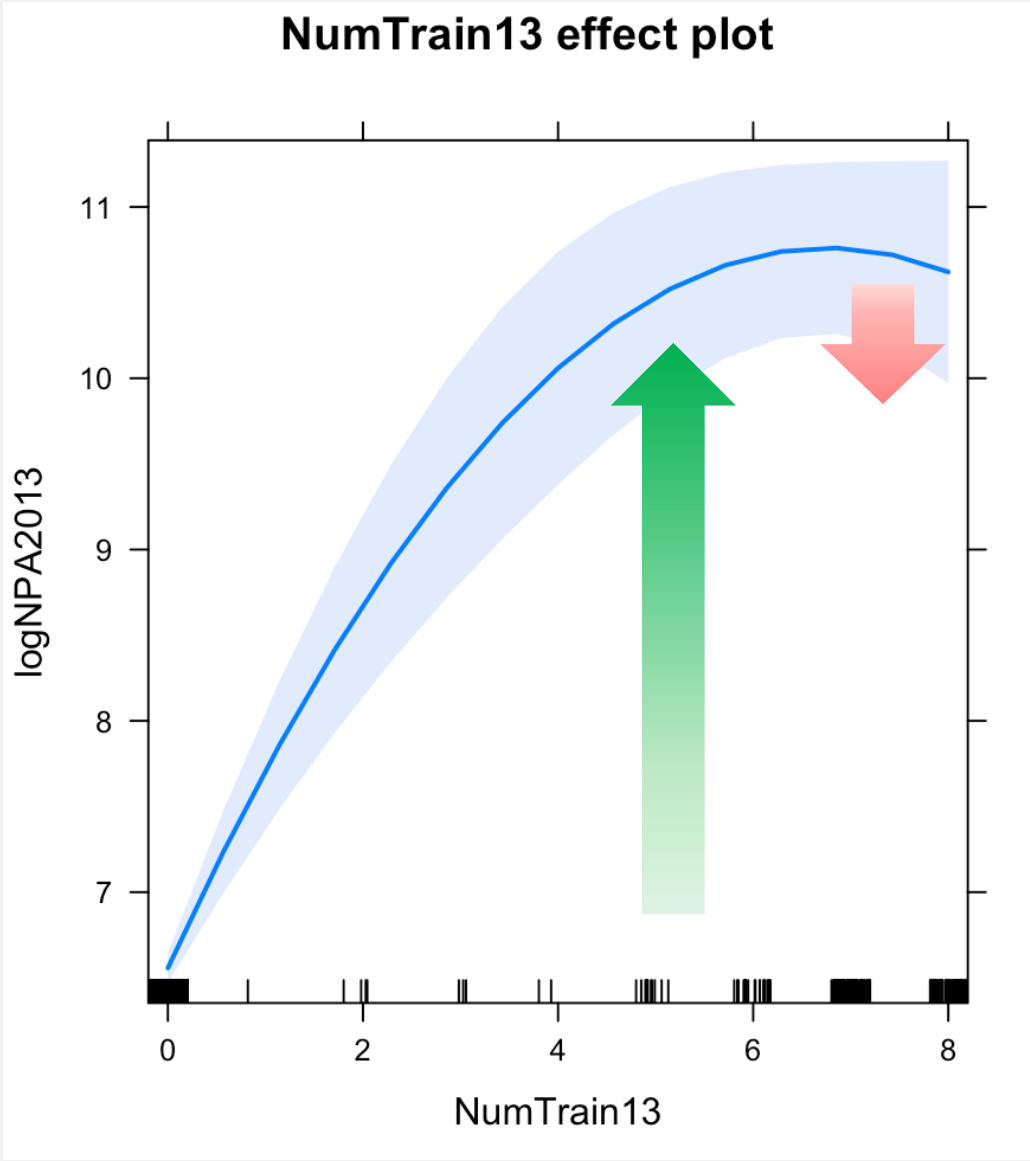
```
t test of coefficients:

                             Estimate Std. Error t value  Pr(>|t|)
(Intercept)                 5.5703354  0.1880174 29.6267 < 2.2e-16 ***
logNPA2012                  0.2729412  0.0108370 25.1860 < 2.2e-16 ***
NumTrain12                  0.3296987  0.0802496  4.1084 4.100e-05 ***
NumTrain13                  1.2437414  0.1169591 10.6340 < 2.2e-16 ***
I(NumTrain13^2)            -0.0918897  0.0161895 -5.6759 1.523e-08 ***
SA_Full                     0.0799804  0.0994836  0.8040 0.4214917
SA_Temp                    -0.1356544  0.1149702 -1.1799 0.2381378
SA_YearsofService          -0.0727680  0.0127229 -5.7194 1.183e-08 ***
Cgenderdummy                0.9200936  0.1750832  5.2552 1.591e-07 ***
age_band                   -0.0666151  0.0187213 -3.5583 0.0003796 ***
est_income_code             0.0387909  0.0297280  1.3049 0.1920488
NumTrain12:NumTrain13      -0.0997055  0.0158816 -6.2781 3.968e-10 ***
NumTrain13:SA_YearsofService  0.0071511  0.0023841  2.9995 0.0027282 **
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

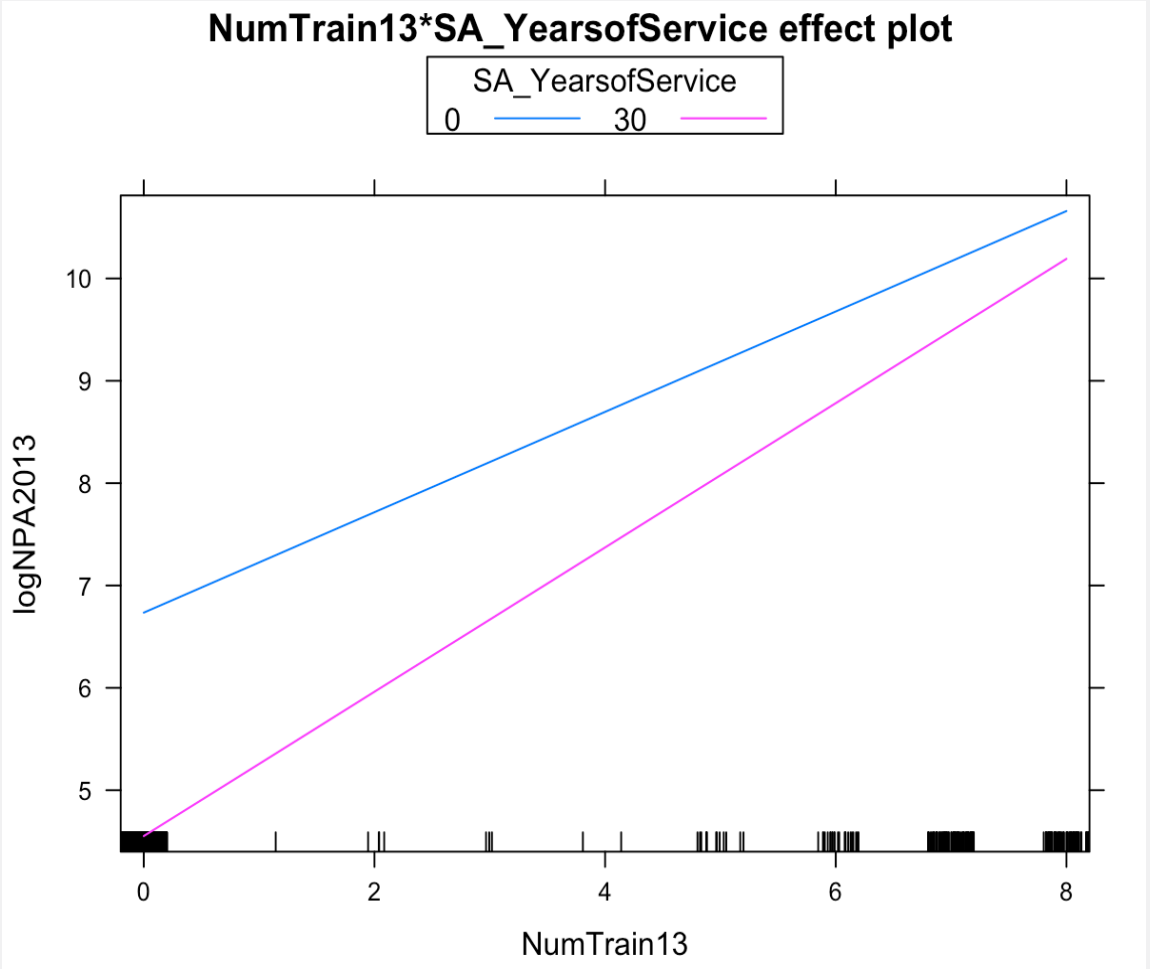
Interpretation of individual variables

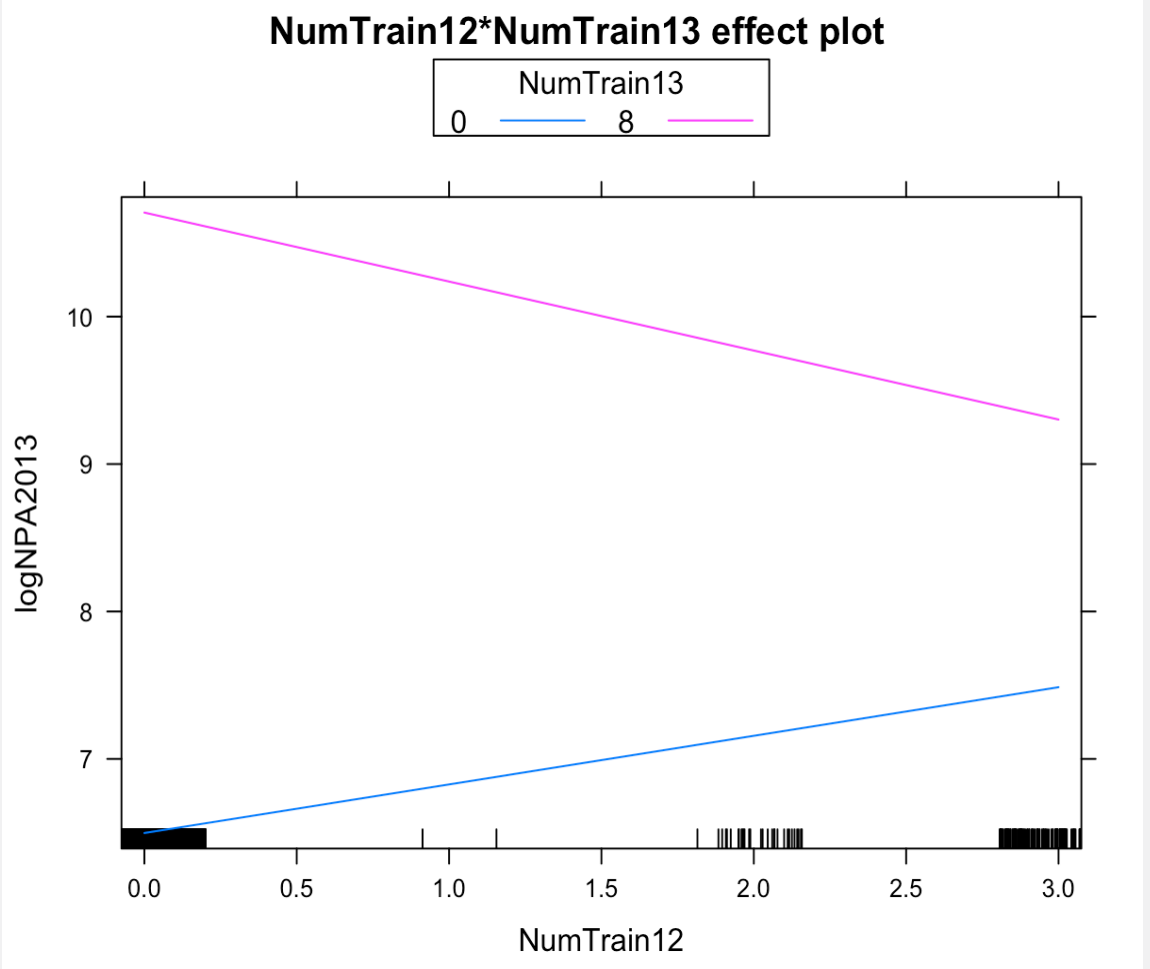
Variables	β	*Result*
NPA2012	0.3	For each 1% increase in sales the year before, employee sales increase by roughly 30%
NumTrain12	0.3	For each additional training module completed in 2012, employee sales decrease by roughly 3%
SA_Full	0.08	Employee sales are roughly 8% higher for full-time employees
SA_Temp	-0.1	Employee sales are roughly 10% lower for temporary employees
SA_YearsofService	-0.1	For each additional year of employment, employee sales decrease by roughly 10%
Cgenderdummy	0.9	Employee sales are roughly 90% higher with female customers
age_band	-0.1	For each 1 unit increase in customer age group, employee sales increase by roughly 10%
est_income_code	-0.04	For each 1 unit increase in customer income level, employee sales decrease by roughly 4%

Interpretation of individual variables



Interpretation of interaction terms





Research Question 2:

What is the impact of salesperson training on consumer returns?

Final Dataset

EID	Sales amount		Consumer Demography		SA demography		Mall Information		Training & Return	
	2013sales	2012sales	gender	age_band	SA_gender	SA_AssignmentCategory	MallSalesSF	StoreSqFt	training2012	2013return_amount
7	1054.00	39.98	0.0000000	0.000000	0	1	320	1269	0	NA
130	54500.60	60.00	0.6582915	5.155779	0	0	320	1212	1	4574.92
390	35931.93	94.99	0.5929204	3.876106	0	1	265	2646	0	5070.74
358	2884.23	216.00	0.7777778	7.222222	0	1	345	1300	0	1414.99
359	2884.23	216.00	0.7777778	7.222222	0	1	245	1635	0	1414.99
295	6068.15	235.14	0.5263158	6.263158	1	1	320	1269	0	931.31
42	799.00	271.56	0.0000000	5.000000	0	1	320	1269	0	NA

Theoretical Models

- 2012
- $\boldsymbol{return\_amount2012}\sim\beta_0 + \beta_1 training2012 + \beta_2 sales2012 + \beta_3 est\_income\_code + \beta_4 SA\_YearsofServes + \beta_5 MallSalesSF + \beta_6 TotalCases + \beta_7 StoreSqFt + \beta_8 MajorCompetitorPresent + \beta_9 homeowner_{code} + \beta_{10} I(SA\_YearsofService\text{^}2) + \mathcal{E}$
- 2013
- $\boldsymbol{return\_amount2013}\sim\beta_0 + \beta_1 training2013 + \beta_2 training2012 * training2013 + \beta_3 est\_income\_code + \beta_4 SA\_YearsofServes + \beta_5 MallSalesSF + \beta_6 TotalCases + \beta_7 StoreSqFt + \beta_8 MajorCompetitorPresent + \beta_9 homeowner_{code} + \beta_{10} SA\_AssignmentCategory + \beta_{11} I(SA\_YearsofService\text{^}2) + \mathcal{E}$

Theoretical Models

2012

Coefficients:

	Estimate	Std. Error	t value	Pr(>|t|)	
(Intercept)	-7.613e+04	1.059e+04	-7.192	3.83e-12	***
training2012	5.315e+03	2.370e+03	2.243	0.025522	*
sales2012	7.309e+03	6.763e+02	10.806	< 2e-16	***
est_income_code	1.590e+03	1.506e+03	1.056	0.291635	
SA_YearsofService	2.283e+03	5.538e+02	4.122	4.68e-05	***
MallSalesSF	4.123e+01	1.121e+01	3.677	0.000273	***
TotalCases	-2.729e+02	2.384e+02	-1.145	0.253005	
StoreSqFt	-1.276e-01	2.674e+00	-0.048	0.961955	
MajorCompetitorPresent	-3.987e+02	2.636e+03	-0.151	0.879881	
homeowner_code	-3.313e+03	7.729e+03	-0.429	0.668427	
I(SA_YearsofService^2)	-7.324e+01	2.274e+01	-3.220	0.001400	**

2013

Coefficients:

	Estimate	Std. Error	t value	Pr(>|t|)	
(Intercept)	-16039.634	11164.692	-1.437	0.151735	
training2013	7402.868	2006.626	3.689	0.000262	***
training2012	3722.924	4269.398	0.872	0.383819	
MajorCompetitorPresent	3712.757	3275.583	1.133	0.257813	
SA_AssignmentCategory	12473.356	2900.861	4.300	2.23e-05	***
TotalCases	2.174	283.942	0.008	0.993896	
I(SA_YearsofService^2)	-62.696	28.265	-2.218	0.027200	*
SA_YearsofService	1712.649	729.264	2.348	0.019420	*
est_income_code	1622.712	1781.776	0.911	0.363081	
homeowner_code	543.240	10682.775	0.051	0.959473	
training2013:training2012	6518.175	3001.556	2.172	0.030573	*

Final Models

- 2012
- $\boldsymbol{return\_amount2012}\sim\beta_0 + \beta_1 training2012 * SA\_AssignmentCategory + \beta_2 sales2012 + \beta_3 est\_income\_code + \beta_4 SA\_YearsofServes + \beta_5 MallSalesSF + \beta_6 TotalCases + \beta_7 StoreSqFt + \beta_8 MajorCompetitorPresent + \beta_9 homeowner_{code} + \beta_{10} I(SA\_YearsofService\text{^}2) + \mathcal{E}$
- 2013
- $\boldsymbol{return\_amount2013}\sim\beta_0 + \beta_1 training2013 * SA\_AssignmentCategory + \beta_2 training2012 * training2013 + \beta_3 est\_income\_code + \beta_4 SA\_YearsofServes + \beta_5 MallSalesSF + \beta_6 TotalCases + \beta_7 StoreSqFt + \beta_8 MajorCompetitorPresent + \beta_9 homeowner_{code} + \beta_{10} SA\_AssignmentCategory + \beta_{11} I(SA\_YearsofService\text{^}2) + \mathcal{E}$

Final Models

2012

Coefficients:

	Estimate	Std. Error	t value	Pr(>|t|)	
(Intercept)	-6.779e+04	1.063e+04	-6.380	5.71e-10	***
training2012	-4.680e+03	3.492e+03	-1.340	0.181041	
SA_AssignmentCategory	-1.265e+03	2.996e+03	-0.422	0.673234	
sales2012	6.851e+03	6.792e+02	10.087	< 2e-16	***
est_income_code	1.713e+03	1.560e+03	1.098	0.272893	
SA_YearsofService	2.485e+03	5.556e+02	4.473	1.05e-05	***
MallSalesSF	4.300e+01	1.104e+01	3.894	0.000119	***
TotalCases	-2.970e+02	2.367e+02	-1.254	0.210557	
StoreSqFt	-5.337e-01	2.686e+00	-0.199	0.842611	
MajorCompetitorPresent	-5.612e+02	2.600e+03	-0.216	0.829221	
homeowner_code	-7.809e+03	8.606e+03	-0.907	0.364849	
I(SA_YearsofService^2)	-8.164e+01	2.262e+01	-3.610	0.000352	***
training2012:SA_AssignmentCategory	1.540e+04	4.324e+03	3.563	0.000419	***

2013

Coefficients:

	Estimate	Std. Error	t value	Pr(>|t|)	
(Intercept)	-8258.37	11139.47	-0.741	0.45899	
training2013	1745.01	2391.33	0.730	0.46606	
SA_AssignmentCategory	752.26	4024.44	0.187	0.85183	
training2012	4044.67	4189.86	0.965	0.33506	
MajorCompetitorPresent	4063.47	3211.55	1.265	0.20664	
TotalCases	-76.72	279.14	-0.275	0.78360	
I(SA_YearsofService^2)	-69.91	27.73	-2.521	0.01215	*
SA_YearsofService	1911.96	715.75	2.671	0.00792	**
est_income_code	1721.31	1748.54	0.984	0.32561	
homeowner_code	[illegible]	[illegible]	[illegible]	[illegible]	
training2013:SA_AssignmentCategory	11734.84	2841.88	4.129	4.58e-05	***
training2013:training2012	4338.47	2987.55	1.452	0.14737	

Robust standard error

2012

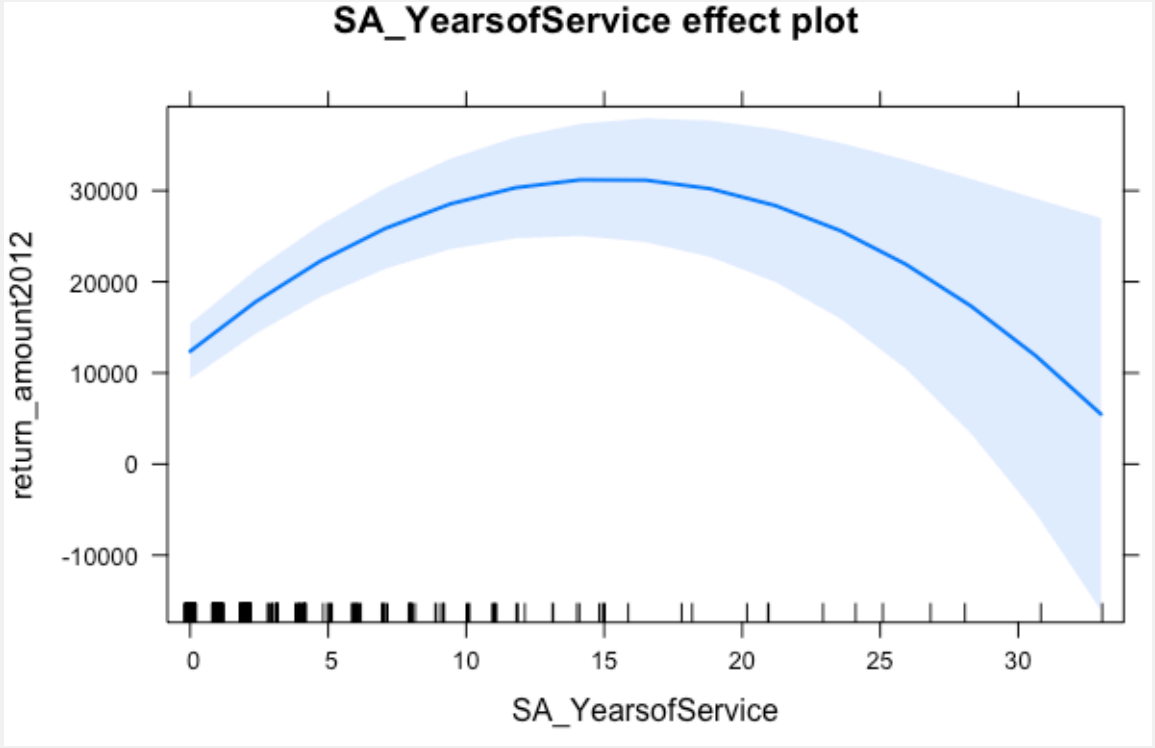
	Estimate	Std. Error	z value	Pr(>|z|)	
(Intercept)	-6.7786e+04	1.1771e+04	-5.7586	8.483e-09	***
training2012	-4.6797e+03	2.7454e+03	-1.7046	0.0882739	.
SA_AssignmentCategory	-1.2647e+03	2.2202e+03	-0.5696	0.5689209	
sales2012	6.8508e+03	7.2979e+02	9.3874	< 2.2e-16	***
est_income_code	1.7128e+03	1.1148e+03	1.5364	0.1244505	
SA_YearsofService	2.4851e+03	8.2354e+02	3.0176	0.0025481	**
MallSalesSF	4.3002e+01	2.3230e+01	1.8511	0.0641534	.
TotalCases	-2.9697e+02	2.9437e+02	-1.0088	0.3130598	
StoreSqFt	-5.3368e-01	2.9022e+00	-0.1839	0.8541007	
MajorCompetitorPresent	-5.6116e+02	2.2780e+03	-0.2463	0.8054163	
homeowner_code	-7.8089e+03	6.9964e+03	-1.1161	0.2643665	
I(SA_YearsofService^2)	-8.1639e+01	2.7676e+01	-2.9498	0.0031796	**
training2012:SA_AssignmentCategory	1.5404e+04	4.1909e+03	3.6757	0.0002372	***

2013

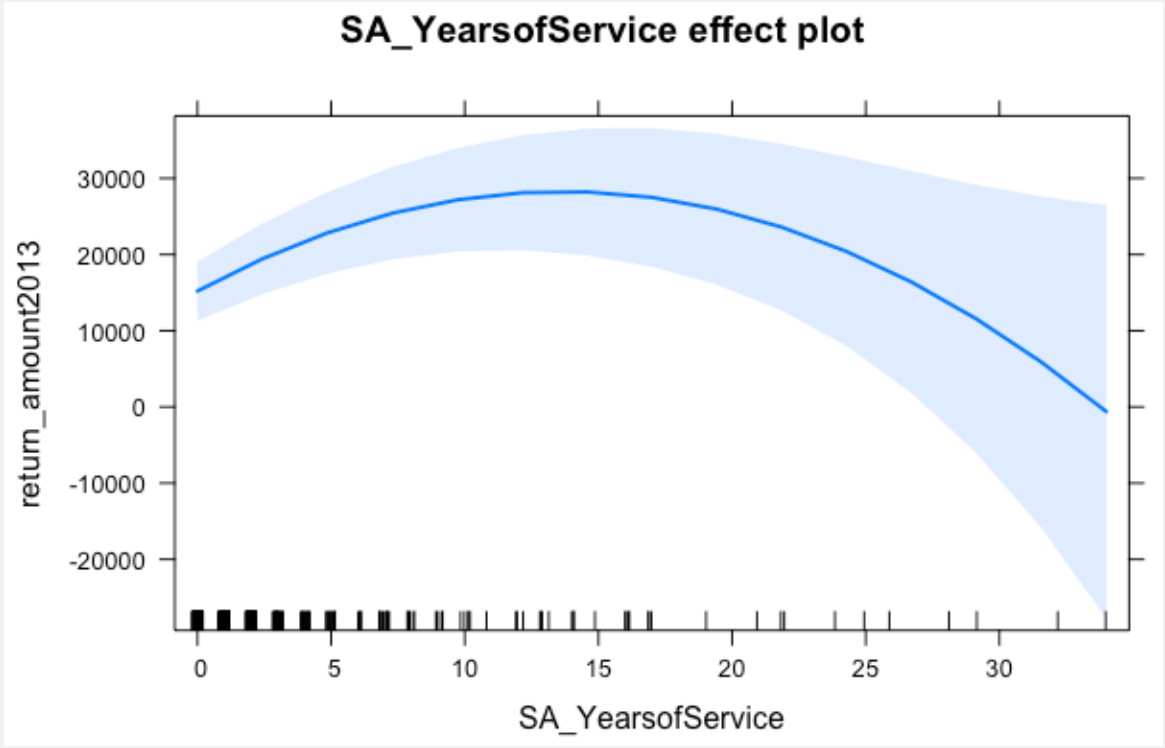
	Estimate	Std. Error	z value	Pr(>|z|)	
(Intercept)	-8258.371	8592.986	-0.9611	0.33652	
training2013	1745.006	1257.695	1.3875	0.16530	
SA_AssignmentCategory	752.263	1794.872	0.4191	0.67513	
training2012	4044.668	2162.246	1.8706	0.06140	.
MajorCompetitorPresent	4063.474	2363.927	1.7190	0.08562	.
TotalCases	-76.720	235.117	-0.3263	0.74419	
I(SA_YearsofService^2)	-69.914	41.133	-1.6997	0.08919	.
SA_YearsofService	1911.955	1156.750	1.6529	0.09836	.
est_income_code	1721.307	1188.900	1.4478	0.14767	
homeowner_code	420.363	5624.890	0.0747	0.94043	
training2013:SA_AssignmentCategory	11734.835	2264.502	5.1821	2.194e-07	***
training2013:training2012	4338.466	2603.894	1.6661	0.09568	.

Quadratic-term

2012

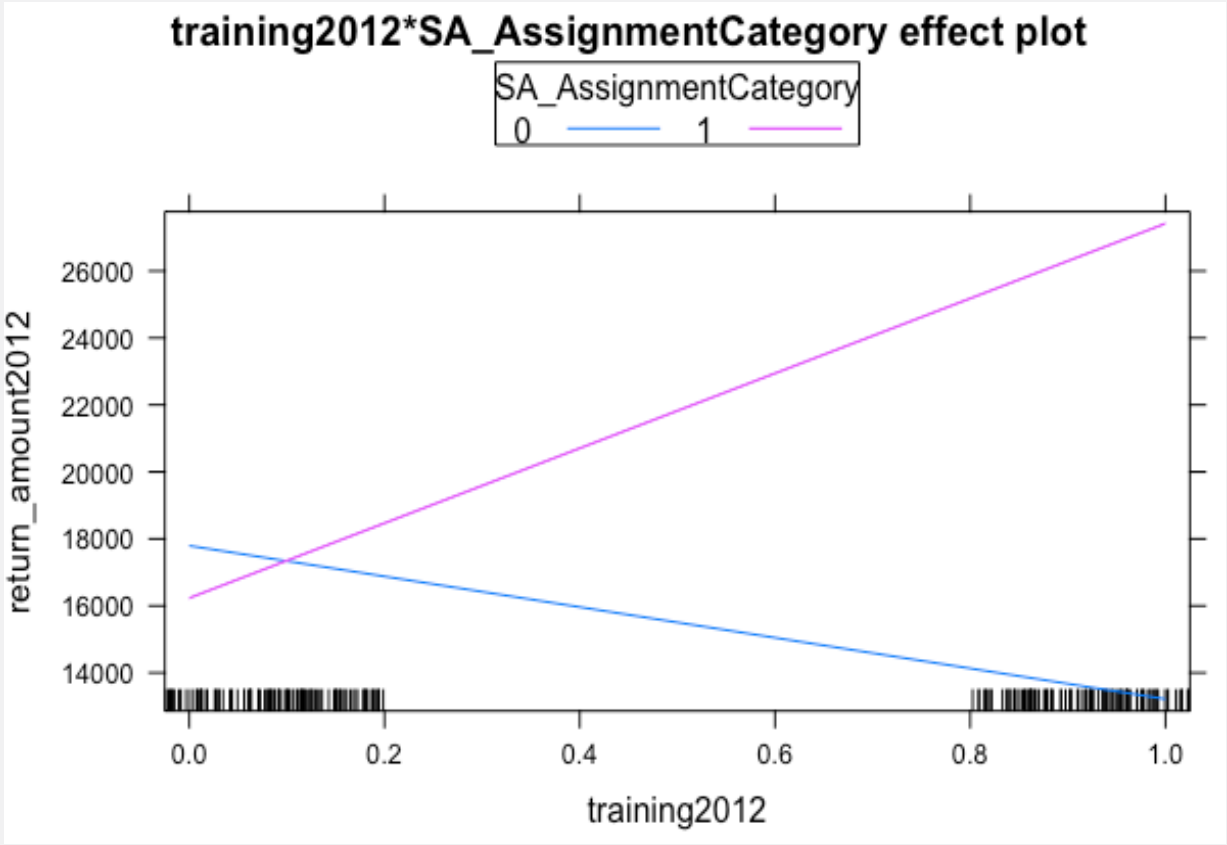


2013

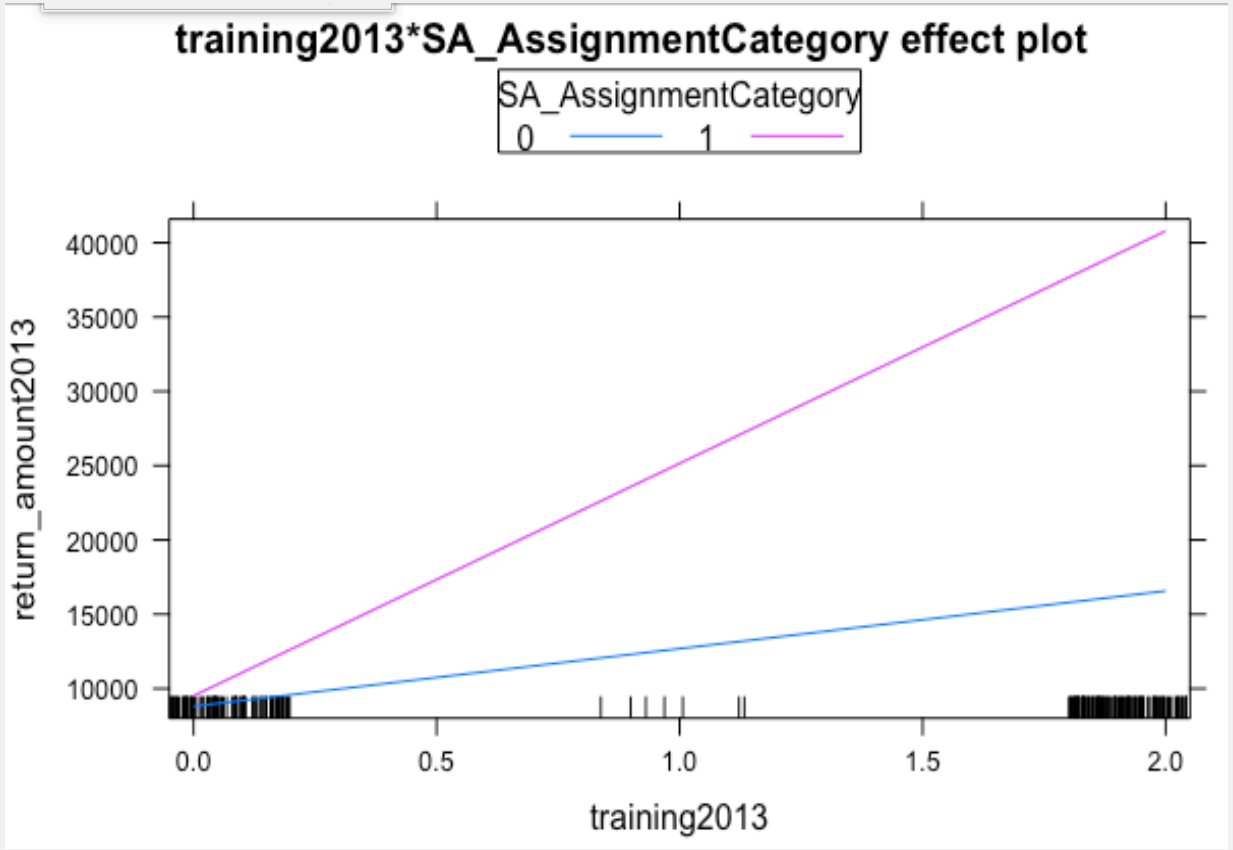


Interaction-term

2012



2013



Research Question 3:

Do customers perceive a trained salesperson more competent than an untrained salesperson?

Data Preparation:

Divided training data in 2 categories of Product Knowledge Training and Service & Selling Skill Training

- **Training Completion for Salesperson**
  - Product Knowledge Training (FY 2013 – 2013)
  - Service & Selling Skill Training (FY2013)
- **Customer Survey from FY 2012 – 2013**
  - Customer Perceived Salesperson Competence of Product Knowledge
  - Customer Perceived Salesperson Competence of Service & Selling Skill Training
- **Sales Transaction Data**
- **Store Attributes**

Final Model

We us two linear regression models to solve the problems:

The dependent variable will be customers' satisfaction from 2 categories :
The perceived Product Knowledge from salesperson and the satisfaction of salesperson's Service & Selling Skill

Model 1

Total Competence Scores of Sales Person's Product Knowledge in 2012 & 2013~

Product training level + I(Product training level^2) + Product training level * SA_Assignment Category

+ Customer demographics + Sales Person demographics + Transaction & Store Variables

Model 2

Total Competence Scores of Sales Person's Service & Selling Skill in 2013~

Service training level 2013 + *2013 Product Competence Score + Customer demographics + Sales Person demographics + Transaction & Store Variables*

Final Model 1 –The Impact of Product Training

Total Competence Scores of Sales Person's Service & Selling Skill ~

Product training level + I(Product training level^2) + Product training level *

SA_Assignment Category + *Purchase basket size + log(net_purchase_amount) + Return + Gender + age_band + SA_Years of Service + SA_Rate of Pay +SA_Assignment Category + factor(Mall Grade)+Total Cases*

Final Model 1 –The Impact of Product Training

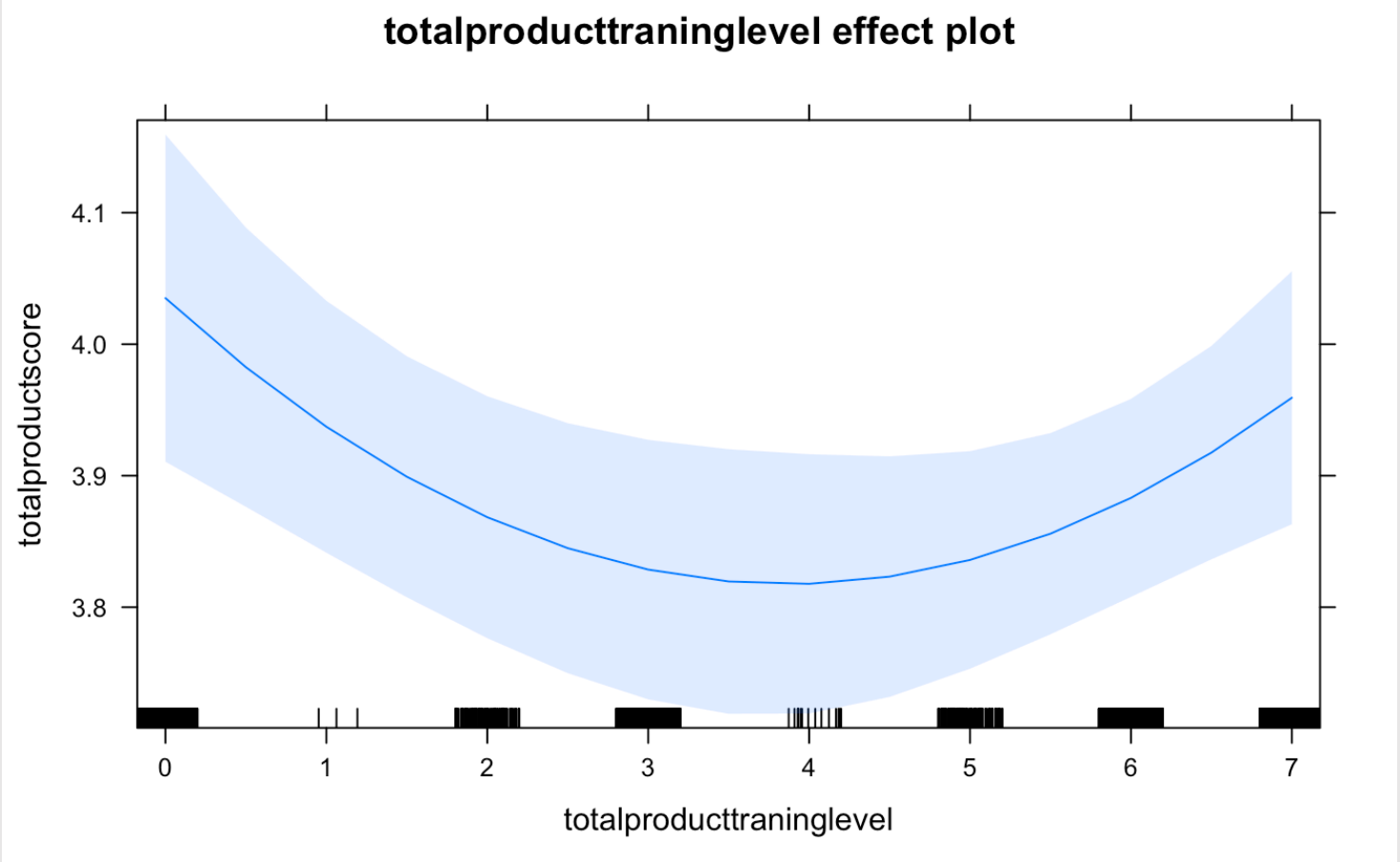
t test of coefficients:

	Estimate	Std. Error	t value	Pr(>|t|)	
(Intercept)	2.7240e+00	3.1225e-01	8.7237	< 2.2e-16	***
totalproducttraninglevel	-1.6395e-01	4.6421e-02	-3.5317	0.0004212	***
I(totalproducttraninglevel^2)	1.4496e-02	6.6316e-03	2.1859	0.0289275	*
SA_AssignmentCategory	-5.2023e-02	1.1112e-01	-0.4682	0.6397162	
purchasebasketsize	2.5628e-02	6.3658e-03	4.0259	5.867e-05	***
net_purchase_amount_log	1.2578e-01	2.2876e-02	5.4984	4.272e-08	***
return	6.0716e-02	8.5759e-02	0.7080	0.4790331	
gender	8.6705e-02	6.3713e-02	1.3609	0.1736924	
age_band	-2.8990e-03	7.0384e-03	-0.4119	0.6804674	
SA_gender	7.1791e-02	8.2072e-02	0.8747	0.3818158	
SA_YearsofService	9.4239e-03	4.4503e-03	2.1176	0.0343210	*
SA_RateofPay	-1.4230e-04	8.0743e-05	-1.7624	0.0781347	.
Amall	-2.8323e-01	1.0974e-01	-2.5809	0.0099180	**
Cmall	1.8120e-01	7.3120e-02	2.4781	0.0132832	*
Fmall	2.8920e-01	9.4971e-02	3.0452	0.0023526	**
TotalCases	1.6137e-02	8.0864e-03	1.9956	0.0461011	*
totalproducttraninglevel:SA_AssignmentCategory	6.6107e-02	2.4664e-02	2.6803	0.0074107	**

** After robust standard test*

Final Model 1 –The Impact of Product Training

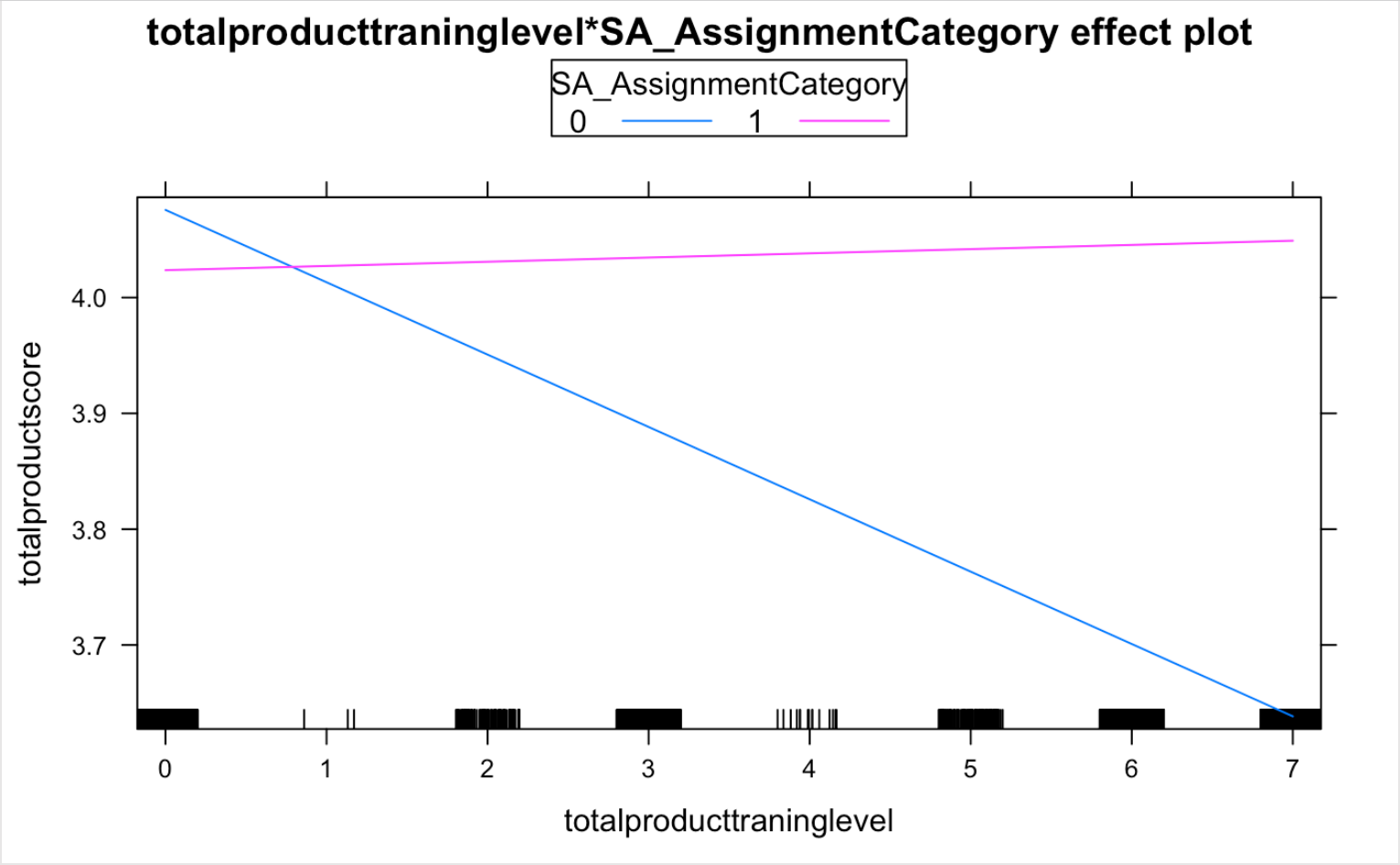
Training of product knowledge becomes more effective after a salesperson taking more than 3 ~ 4 training. The entry level of training does not give a positive effect.



Final Model 1 –The Impact of Product Training

Full-time salesperson has stable performance after training.

For part-time salesperson, training has negative affect.



Final Model 2 – The Impact of Service Training

Total Competence Scores of Sales Person's Service & Selling Skill ~

***Service training level 2013 + Service training level** + Product Score + Purchase basket*

size + log(net_purchase_amount) + Return + Gender + Age_band + SA_Assignment

Category + SA_Years of Service + SA_Rate of Pay +

SA_Gender+Amall+Cmall+Fmall+MallSalesSF+TotalCase

2SLS estimator & Identify IV for Model 2

Endogeneity: Service training level but without ideal IVs

IV : SA_MartialStatus + SA_Dependent

```
Coefficients:
                          Estimate Std. Error t value Pr(>|t|)
(Intercept)              5.033e+00  6.002e-01   8.386  < 2e-16 ***
servicetraninglevel2013 -3.716e-01  4.376e-01  -0.849  0.39589
productscore2013         1.770e-01  1.071e-02  16.517  < 2e-16 ***
purchasebasketsize      -8.470e-03  1.323e-02  -0.640  0.52206
net_purchase_amount_log -3.047e-02  1.008e-02  -3.023  0.00255 **
return                  -5.540e-02  4.340e-02  -1.277  0.20195
gender                   1.524e-03  2.545e-02   0.060  0.95225
age_band                 6.734e-03  3.141e-03   2.144  0.03221 *
SA_gender               -4.044e-02  3.614e-02  -1.119  0.26323
SA_YearsofService       -5.833e-03  5.998e-03  -0.973  0.33093
SA_RateofPay             8.461e-06  3.608e-05   0.235  0.81461
SA_AssignmentCategory   -6.444e-02  6.337e-02  -1.017  0.30939
Amall                   -1.037e-01  8.525e-02  -1.216  0.22409
Cmall                   -5.284e-02  3.508e-02  -1.506  0.13222
Fmall                   -8.407e-02  4.956e-02  -1.696  0.09002 .
MallSalesSF              1.464e-04  2.292e-04   0.639  0.52297
TotalCases              -1.548e-02  6.016e-03  -2.572  0.01020 *

Diagnostic tests:
                 df1  df2 statistic p-value
Weak instruments   2 1535     5.875 0.00287 **
Wu-Hausman         1 1535     0.583 0.44538
Sargan             1   NA     0.216 0.64217
```

IV : SA Assignment Category

```
Coefficients:
                          Estimate Std. Error t value Pr(>|t|)
(Intercept)              5.709e+00  4.332e-01  13.180  < 2e-16 ***
servicetraninglevel2013 -8.810e-01  2.741e-01  -3.214 0.001336 **
productscore2013         1.749e-01  1.182e-02  14.792  < 2e-16 ***
purchasebasketsize      -2.314e-02  8.490e-03  -2.725 0.006501 **
net_purchase_amount_log -3.517e-02  1.057e-02  -3.328 0.000894 ***
return                  -2.810e-02  4.288e-02  -0.655 0.512337
gender                  -1.544e-03  2.853e-02  -0.054 0.956859
age_band                 7.646e-03  3.482e-03   2.196 0.028241 *
SA_gender               -4.232e-02  4.076e-02  -1.038 0.299239
SA_YearsofService       -1.238e-02  3.928e-03  -3.151 0.001661 **
SA_RateofPay             3.199e-05  3.776e-05   0.847 0.397056
Amall                   -1.609e-01  7.999e-02  -2.011 0.044464 *
Cmall                   -7.044e-02  3.726e-02  -1.891 0.058871 .
Fmall                   -6.747e-02  5.361e-02  -1.259 0.208391
MallSalesSF              9.887e-05  2.563e-04   0.386 0.699683
TotalCases              -2.131e-02  5.170e-03  -4.121 3.97e-05 ***

Diagnostic tests:
                 df1  df2 statistic  p-value
Weak instruments   1 1537     37.59 1.11e-09 ***
Wu-Hausman         1 1536     11.99  0.00055 ***
Sargan             0   NA        NA       NA
```

Final Model 2 –The Impact of Service Training

Training of Service & Selling Skill does not showing a positive effect.

In conclusion for Question 3, from customers' perspective, a trained salesperson does not appear effectively more competent than an untrained salesperson

```
t test of coefficients:

                           Estimate  Std. Error t value  Pr(>|t|)
(Intercept)              4.6019e+00  1.5084e-01 30.5084 < 2.2e-16 ***
servicetraninglevel2013 -4.6763e-02  3.7736e-02 -1.2392 0.2154565
productscore2013         1.7826e-01  1.6642e-02 10.7111 < 2.2e-16 ***
purchasebasketsize       8.8346e-04  3.1018e-03  0.2848 0.7758214
net_purchase_amount_log -2.7464e-02  8.5165e-03 -3.2248 0.0012873 **
return                  -7.2817e-02  4.1593e-02 -1.7507 0.0801950 .
gender                   3.4806e-03  2.5132e-02  0.1385 0.8898714
age_band                 6.1519e-03  2.9614e-03  2.0773 0.0379361 *
SA_gender               -3.9248e-02  3.4053e-02 -1.1526 0.2492723
SA_YearsofService       -1.6615e-03  2.0627e-03 -0.8055 0.4206435
SA_RateofPay            -6.5416e-06  3.6806e-05 -0.1777 0.8589561
SA_AssignmentCategory   -1.0553e-01  2.7538e-02 -3.8323 0.0001321 ***
Amall                   -6.7204e-02  6.4624e-02 -1.0399 0.2985360
Cmall                   -4.1627e-02  2.9797e-02 -1.3970 0.1626089
Fmall                   -9.4660e-02  4.0543e-02 -2.3348 0.0196814 *
MallSalesSF              1.7674e-04  2.1381e-04  0.8266 0.4085799
TotalCases              -1.1758e-02  3.3332e-03 -3.5275 0.0004318 ***
---
```

** After robust standard test*

Suggestions & Limitations

- *Continue the training program*
- *Require the training program for new employees*
- *Require the product training for experienced employees*

- *Record data for product quality*
- *Would be more accurate with less employee turn-over*

Thanks!