BIOS767_HW7

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For more background about the study, see the relevant papers are in the papers folder. Note that "Exposure" is a subject-level variable. It is not updated year to year as the word "previous" might suggest.

14.2.0: Given the study design and objectives, present some descriptive statistics, including the distribution of the number of observations per subject.

According to our question the main objective of the analyses is to compare the effects of beta carotene on skin cancer rates.The outcome variable is a count of the number of new skin cancers per year.

	Placebo	Beta Carotene	Total
Center 1	971	912	1883
Center 2	612	636	1248
Center 3	535	563	1098
Center 4	1406	1446	2852
Total	3524	3557	7081

	Female	Male	Total
Center 1	743	1140	1883
Center 2	321	927	1248
Center 3	211	887	1098
Center 4	988	1864	2852
Total	2263	4818	7081

	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Center 1	422	413	397	377	274	1883
Center 2	315	298	276	236	123	1248
Center 3	253	243	236	229	137	1098
Center 4	693	676	661	545	277	2852
Total	1683	1630	1570	1387	811	7081

	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Placebo	827	803	776	699	419	3524
Beta Carotene	856	827	794	688	392	3557
Total	1683	1630	1570	1387	811	7081

	No Burn	Skin	Total
Placebo	1961	1563	3524
Beta Carotene	1932	1625	3557

	No Burn	Skin	Total
Total	3893	3188	7081

Mean Tables For Exposure (count of the number of previous skin cancers)

skin	N	Mean	SD	Minimum	Maximum
0	3893	2.45	2.89	1.00	21.00
1	3188	3.33	3.81	1.00	21.00

treatment	N	Mean	SD	Minimum	Maximum
0	3524	2.78	3.31	1.00	21.00
1	3557	2.92	3.40	1.00	21.00

gender	N	Mean	SD	Minimum	Maximum
0	2263	2.42	2.64	1.00	21.00
1	4818	3.05	3.63	1.00	21.00

center	N	Mean	SD	Minimum	Maximum
1	1883	2.60	3.03	1.00	21.00
2	1248	4.24	4.56	1.00	21.00
3	1098	3.40	3.94	1.00	21.00
4	2852	2.19	2.34	1.00	21.00

Mean Tables For Age

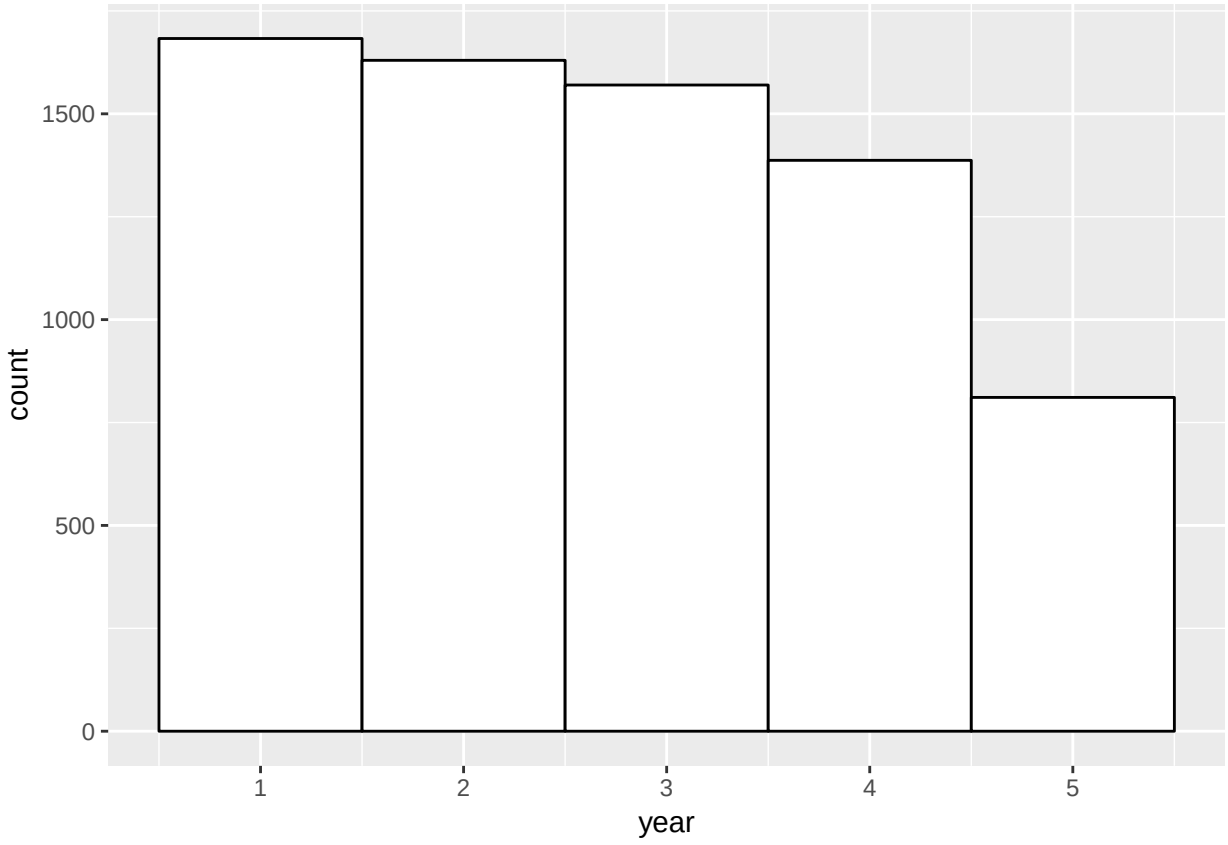
skin	N	Mean	SD	Minimum	Maximum
0	3893	62.88	9.93	28.00	84.00
1	3188	63.14	9.82	29.00	84.00

treatment	N	Mean	SD	Minimum	Maximum
0	3524	63.05	9.72	30.00	83.00
1	3557	62.94	10.04	28.00	84.00

gender	N	Mean	SD	Minimum	Maximum
0	2263	63.39	9.33	32.00	83.00
1	4818	62.82	10.13	28.00	84.00

center	N	Mean	SD	Minimum	Maximum
1	1883	63.75	9.31	31.00	83.00

center	N	Mean	SD	Minimum	Maximum
2	1248	63.60	9.58	31.00	84.00
3	1098	64.78	7.12	37.00	80.00
4	2852	61.55	11.03	28.00	84.00



14.2.1: Consider a generalized linear mixed model, with randomly varying intercepts, for the subject-specific log rate of skin cancers. Using maximum likelihood (ML), fit a model with linear trends for the log rate over time and allow the slopes to depend on treatment group: $log(E(Y_{ij}|b_i)) = (\beta_1 + b_i) + \beta_2 Year_{ij} + \beta_3 Treatment_i * Year_{ij}$

Model:$log(E(Y_{ij}|b_i)) = (\beta_1 + b_i) + \beta_2 Year_{ij} + \beta_3 Treatment_i * Year_{ij}$

Parameter	Estimate	SE
β_1	-2.337	0.08155
β_2	-0.0077	0.02258
β_3	0.0491	0.02584
σ_b	2.1448	0.1632

14.2.2: What is the estimate of σ_b^2? Give an interpretation to the magnitude of the estimated variance?

$\hat{\sigma}_b$=2.1448

The estimate is $\hat{\sigma}_b = 2.1448$. This reflects the between subject variance for beta carotene at baseline.This implied that there is relatively not substantial variability in the propensity to experience skin cancer since 95% of the subjects have a baseline rate of skin cancer that varies from 0.0055% to 1.705%

14.2.3: What is the interpretation of the estimate of β_2?

$\hat{\beta}_2$=-0.0077

-0.0077 is the estimated change in log rate of skin cancer at year 1 between subjects receiving beta carotene and patients receiving placebo.

14.2.4: What is the interpretation of the estimate of β_3?

$\hat{\beta}_3$=0.0491

0.0491 is the estimated change in the log rate of skin cancer at year 1 between subjects receiving beta carotene and patients receiving placebo.

14.2.5: From the results of the analysis for Problem 14.2.1, what conclusions do you draw about the effect of beta carotene on the log rate of skin cancers? Provide results that support your conclusions.

β_3 is the treatment effect of beta carotene on the log rate of skin cancer by looking at the log rate of skin cancer at year 1 between subjects receiving beta carotene and subjects receiving placebo. A Wald test can be appropriate to test the effect.

$H_0 : \beta_3 = 0$

H_A: Otw

$\chi^2_{stat} = 1.63$

df=1

p-value=0.2021

$\alpha = 0.05$

Decision: Fail to reject H_0

Conclusion: The difference in the log rate of skin cancer at year 1 between subjects receiving beta carotene and subjects receiving placebo is not significant.

14.2.6 Obtain the predicted (empirical BLUP) random effect for each subject.

See attached for predicted eBLUP's for each subject

14.2.6A: Calculate the sample variance of the predictions. How does it compare to

the estimate of σ_b^2 obtained in Problem 14.2.2? Why might they differ?

Sample variance of the predictions is 1.035. The estimate of σ_b we obtained in 14.2.2 was 2.1448. These could differ because the EBLUP's are predicted while the σ_b was estimated using maximum likelihood.

14.2.6B: Plot the predictions against age and the count of the number of previous skin cancers. What do you conclude?

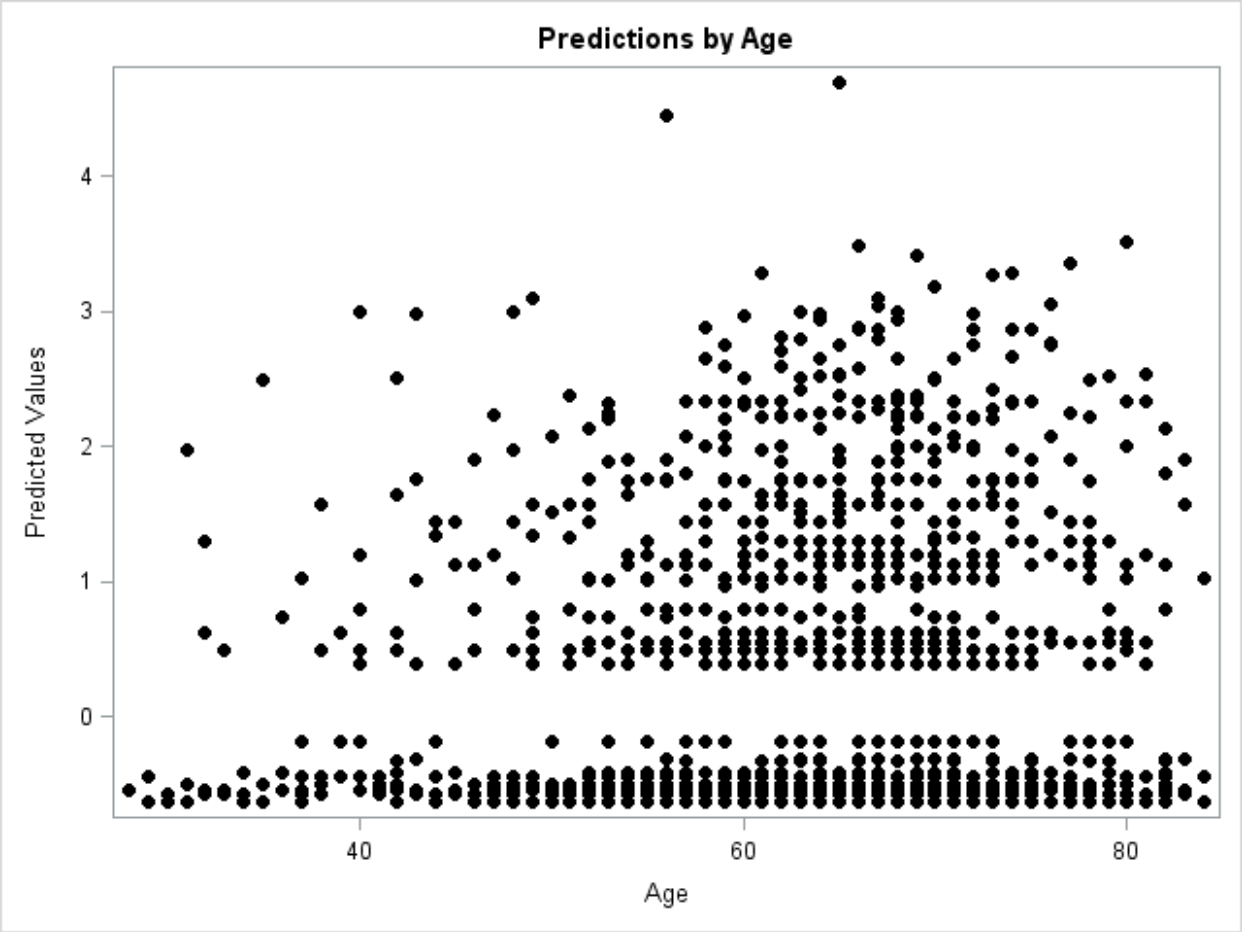


Figure 1:

From the two graphs, we see that the predictions are higher as age increases (the predictions are skewed towards higher age) and that the distribution of the predictions are relatively uniform except for the extreme of the number of skin cancers.

14.2.7: Repeat the analysis from Problem 14.2.1 adjusting for skin type, age, and the count of the number of previous skin cancers. What conclusions do you draw about the effect of beta carotene on the adjusted log rate of skin cancers?

Parameter	Estimate	SE
Intercept	-4.123	0.3079
year	-0.002	0.0219
skin	0.3294	0.0868
exposure	0.1866	0.0105
age	0.0185	0.0046
year*trt	0.0421	0.0239

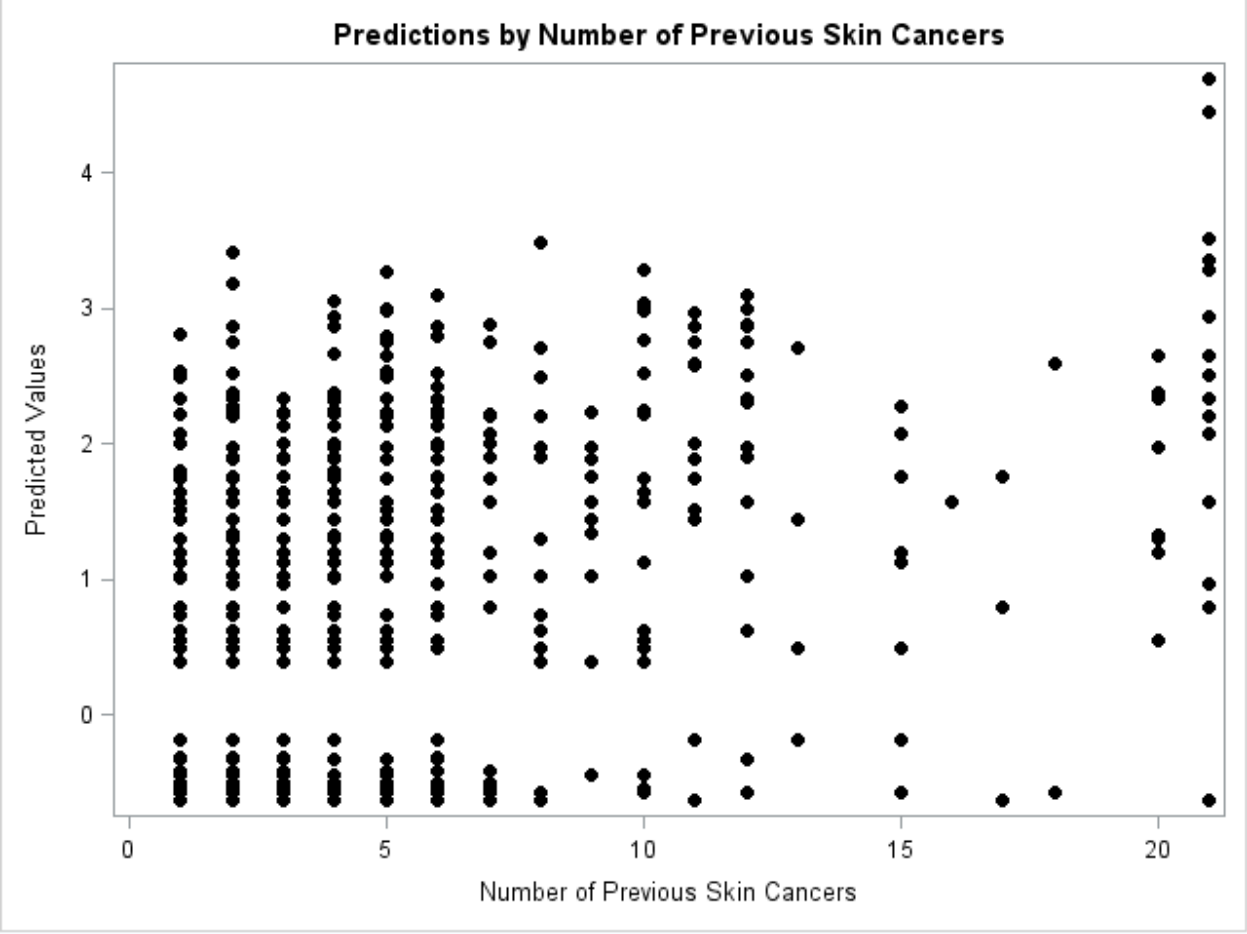

Predictions by Number of Previous Skin Cancers
Predicted Values
4
3
2
1
0
0
5
10
15
20
Number of Previous Skin Cancers

Figure 2:

0.0421 is the estimated change in the log rate of skin cancer at year 1 between subjects receiving beta carotene and patients receiving placebo and having the same skin, exposure, and age.

14.2.8 Do you think the randomization did a "good job"? Present summaries that support your answer.

I think the randomization did a good job since the estimate corresponding to the year*trt for the model in 14.2.1 is relatively similar to the model adjusting for covariates. More specifically, in part 14.2.7 we found that 0.0421 is the estimated change in the log rate of skin cancer at year 1 between subjects receiving beta carotene and patients receiving placebo and having the same skin, exposure, and age. While i 14.2.1, 0.0491 is the estimated change in the log rate of skin cancer at year 1 between subjects receiving beta carotene and patients receiving placebo.Since the estimates are relatively the same for the model adjusting for covariates and the model without covariates, I would say the randomization did a 'good job'.

14.2.9 The variable "Exposure" is a count. There are no subjects with Exposure = 0. Why?

The point of the study is to see the outcomes of high risk subjects, thus does not include patients that never had skin cancer.