Applied Exam: 2018

1.a. hypertension: $Z \approx \frac{.111}{.031} = 3.581$ significant compared to $Z^* = 1.96$

smoking: $Z \approx \frac{.234}{.072} = 3.25$ significant compared to $Z^* = 1.96$

age: $Z \approx \frac{.100}{.100} = 1$ not significant compared to $Z^* = 1.96$

1.b. odds ratio: $e^{\beta_1 x}$

odds ratio $= e^{.100(2)} = 1.22$

The odds of sudden death for woman 1 who is 10 years older than woman 2 is 1.22 times the odds of sudden death for woman 2 assuming all other factors are held constant.

C.I.: $e^{\hat{\beta}x \pm 1.96 SE(\hat{\beta})}$

$e^{.100(2) \pm 1.96(.100)} = \boxed{(1.004, 1.486)}$

1.c. $p = \frac{e^{\beta_0 + \beta_1 x \ldots}}{1 + e^{\beta_0 + \beta_1 x \ldots}}$

$\hat{p} = \frac{e^{-1.750 + .111(1) + .234(1) + .100(12)}}{1 + e^{\cdots}}$

$= \frac{e^{-.205}}{1 + e^{-.205}} \approx \boxed{.449} = 44.9\%$

1.d. No, it is not possible to test this because you can't compare odds ratios that measure different things.

1.c. This is not an accurate claim. First, they only look at the distribution of the cases, not the cases and the controls. Second, there may be more people in this age range (50-55) to start off. A better way would be to calculate the probability of sudden death for each of the age categories.

2. treatment: intervention or usual care

outcome: HbA1c % below 7.5

2.a. point estimates:

$P_{control} = \frac{19}{75} \approx .253$

$P_{intervention} = \frac{30}{75} \approx .4$

95% C.I.'s:

use 95% approximate C.I. due to large sample

$p \pm z_{1-\alpha/2} \sqrt{\frac{p(1-p)}{n}}$

control: $.253 \pm 1.96 \sqrt{\frac{.253(.747)}{75}} \approx \boxed{(.155, .351)}$

intervention: $.4 \pm 1.96 \sqrt{\frac{(.4)(.6)}{75}} \approx \boxed{(.289, .511)}$

b. we can use RR since this is a prospective study.

	HbA1c % < 7.5	HbA1c % ≥ 7.5	
Intervention	30	45	75
control	19	56	75

$\hat{RR} = \frac{.40}{.253} \approx \boxed{1.58}$ or $\boxed{\hat{OR} = 1.96}$

95% C.I. : $\frac{P_1}{P_2} \exp\left[\pm 1.96 \sqrt{\frac{n_{12}}{n_{11}n_1} + \frac{n_{22}}{n_{21}n_2}}\right]$

$1.58 \exp\left[\pm 1.96 \sqrt{\frac{45}{(30)(75)} + \frac{56}{(19)(75)}}\right]$

$1.58 \exp\left[\pm 1.96 (.243512311)\right]$

$\approx \boxed{(.980, 2.546)}$

We are 95% confident that the relative risk of HbA1c % < 7.5 for those who received the intervention compared to those with usual care is between .980 and 2.546. Thus, we do not have a clear indication on whether the intervention was helpful in lowering HbA1c % to a level below 7.5.

2. c. use a χ^2 test

$H_0 : \pi_{control} = \pi_{intervention}$

$H_A : \pi_{control} \neq \pi_{intervention}$

where π is the true probability of HbA1c % below 7.5 for the groups respectively

test statistic $= 3.6674 \sim \chi_1^2$

p-value $= .0555$

fail reject H_0

we do not have sufficient evidence that the true probability of HbA1c % below 7.5 differs for those Type I diabetics who received behavioral intervention and those who just had usual care. Thus, we don't have evidence that the intervention was effective.

$H_0: \pi_{control} = \pi_{treatment}$

$H_A: \pi_{control} \neq \pi_{treatment}$

2.d. ~~use Mantel-Haenszel Test~~

~~$X_1^2 \sim 3.8943$ p-value = .0485~~

~~reject Ho~~

~~We have sufficient evidence that the probability of HbA1c % less than 7.5 is different for males and females that either had the behavioral intervention or did not.~~

2.e. $\hat{OR}_{MH} = 2.0487$

95% C.I.: (1.0041, 4.1800)

$\hat{OR}_{Females}$: 1.9048

$\hat{OR}_{males}$: 2.3333

There is slight evidence that confounding by sex is present. It does appear that the intervention does work slightly better for males.

2.d. look at sex variable

3.a. $H_0: \mu_{non} = \mu_{light} = \mu_{heavy}$

H_A: at least one μ_i is different

where μ_i is the population mean lung function for the respective group

need 2 tests:

$\mu_{non} - \mu_{light}$

$\mu_{non} - \mu_{heavy}$

ANOVA Table

	df	SS	MS	F-value	p-value
Model	2	70.94	35.47	52.24	<.0001
Error	297	201.57	.679		
Total	299	272.51			

df: total $= n-1 = 300-1 = 299$

model = # tests = 2

error = total − model $= 299-2 = 297$

grand mean: 3.2

SSmodel: $(3.78-3.2)^2(100) + (3.23-3.2)^2(100) + (2.59-3.2)^2(100)$

$= 33.64 + .09 + 37.21$

$= 70.94$

SSerror:

$SD = \sqrt{\frac{SSE}{n-1}}$

$.79 = \sqrt{\frac{SSE}{99}}$ $\quad 7.860400753 = \sqrt{SSE}$ $\quad SSE_{non} = 61.7859$

$.86 = \sqrt{\frac{SSE}{99}}$ $\quad 8.556891959 = \sqrt{SSE}$ $\quad SSE_{light} = 73.2204$

$.82 = \sqrt{\frac{SSE}{99}}$ $\quad 8.158896984 = \sqrt{SSE}$ $\quad SSE_{heavy} = 66.5676$

$SS_{error} = 61.7859 + 73.2204 + 66.5676 = 201.5739$

SS Total: $70.94 + 201.57 = 272.51$

MS: $= SS/df$

F-value: $\frac{MSR}{MSE} = 52.24 \sim F_{2,297}$

reject H_0

We have sufficient evidence that the population mean lung function differs for at least one of the smoking groups.

3.b. μ_i = group mean