Subject CT3

Corrections to 2015 study material

Comment

This document contains details of any errors and ambiguities in the Subject CT3 study materials for the 2015 exams that have been brought to our attention. We will incorporate these changes in the study material each year. We are always happy to receive feedback from students, particularly details concerning any errors, contradictions or unclear statements in the courses. If you have any such comments on this course please email them to CT3@bpp.com.

You may also find it useful to refer to the Subject CT3 threads on the Actuarial Discussion Forum. (You can reach the Forum by clicking on the "Discussion Forum" button at the very top of the ActEd homepage (in between the Facebook and Twitter links), or by going to http://www.ActEd.co.uk/forums/.)

Important note

This document was last revised significantly on 23 July 2015.

Chapter 12

Exam Type question solution, page 64 *(23 March 2015)*

In the solution to part (iii) of the second exam question it should read:

Under this null hypothesis, we use:

$$\frac{\bar{x}_B - \bar{x}_A}{\sqrt{s_P^2\left(\frac{1}{n_B}+\frac{1}{n_A}\right)}} \sim t_{n_A+n_B-2}$$

Replacement pages can be found at the end.

Chapter 13 and 14

Appendices *(23 July 2015)*

In Chapters 13 and 14 of the 2015 Subject CT3 notes there are some appendices containing proofs of results that are just quoted in the Core Reading. The proofs in the appendices do not form part of the Core Reading. However, after the April 2015 exam it has become clear that the examiners deem some of these proofs as a higher-order skills application of the principles contained in the notes. Hence, please be aware that they could still be examined and so please ignore any statements suggesting that the proofs are not examinable.

Question and Answer Bank

Question 1.23 *(10 November 2014)*

On page 21 of the solutions, in the alternative solution, the bottom limit of the integral should be $-\infty$. The alternative solution should read:

"Alternatively, from first principles, we could consider the DF of Y :

$$F_Y(y) = P(Y \le y) = P(2X \le y) = P(X \le ½y) = \int_{-\infty}^{½y} \frac{1}{\sqrt{2\pi\sigma^2}} e^{-\frac{(x-\mu)^2}{2\sigma^2}} \, dx$$

We cannot easily work out this integral and we need to obtain $f_Y(y)$:

$$f_Y(y) = F_Y'(y) = \frac{\partial}{\partial y} \int_{-\infty}^{½y} \frac{1}{\sqrt{2\pi\sigma^2}} e^{-\frac{(x-\mu)^2}{2\sigma^2}} \, dx = ½ \times \frac{1}{\sqrt{2\pi\sigma^2}} e^{-\frac{(½y-\mu)^2}{2\sigma^2}}$$

We differentiated the integral using Leibnitz' formula given on page 3 of the Tables."

Question 5.7 *(10 November 2014)*

At the bottom of page 7 of the solutions, the p value should be 0.003% (since $P(t_{98} > 4) \approx P(Z > 4) = 0.00003$). The last paragraph should read:

"For a one-sided test this corresponds to a p value of 0.003%. (The t_{98} distribution is very similar to the standard normal distribution.) So we can confidently reject the null hypothesis and conclude that the under 40s watch more TV than the over 40s. [1]"

X assignments

Solution X4.13(ii) *(17 February 2015)*

There is a $-\mu$ term missing on the third line from the bottom of page 21. It should read:

$$= \frac{1}{n_i} \sum_{j=1}^{n_i} (\mu + \tau_i) - \mu$$

This page has been left blank so you can pull out the replacement pages.

Since the expected frequencies are less than five for 4, 5 and 6 houses burgled, we need to combine these columns together with the 3 column:

	0	1	2	3+
observed	39	38	18	5
expected	30.40	40.04	21.97	7.58

Calculating our statistic:

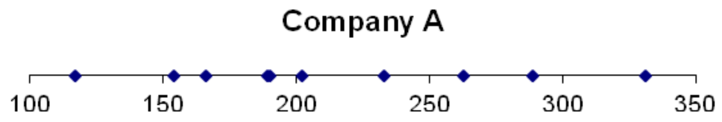
$$\chi^2 = \frac{(39-30.40)^2}{30.40} + \cdots + \frac{(5-7.58)^2}{7.58} = 4.13$$

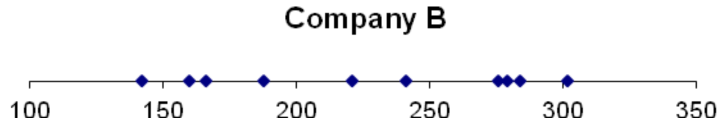
There are now 4 groups so the number of degrees of freedom is $4-1=3$. Remember that the value for p of 0.18 was given and was not estimated using this data.

We are carrying out a one-sided test. Our observed value of the test statistic is less than the 5% critical value of 7.815. So we have insufficient evidence to reject H_0 at the 5% level. Therefore it is reasonable to conclude that the model *is* a good fit.

Exam-type question

(i) We need a line plot showing the sample values for the two companies:





There is perhaps some very slight evidence of concentration at the centre of the distribution for A, but the sample sizes are small and it is difficult to tell whether an assumption of normality is reasonable. The variance of the data from Company B looks slightly smaller than that from Company A. However, it is unlikely that such a small difference is significant. There are no outliers in either distribution.

(ii) We require the variances to be equal, so we are testing:

$$H_0 : \sigma_A^2 = \sigma_B^2 \quad vs \quad H_1 : \sigma_A^2 \neq \sigma_B^2$$

$$s_A^2 = \frac{1}{9}\left(494{,}126 - \frac{2{,}134^2}{10}\right) = 4{,}303.4 \quad s_B^2 = \frac{1}{9}\left(541{,}463 - \frac{2{,}259^2}{10}\right) = 3{,}461.7$$

Using $\dfrac{s_A^2 / s_B^2}{\sigma_A^2 / \sigma_B^2} \sim F_{n_A - 1, n_B - 1}$ we obtain a test statistic of:

$$\frac{4{,}303.4/3{,}461.7}{1} = 1.243$$

We are carrying out a two-sided test. Comparing our statistic with the $F_{9,9}$ distribution, we see that it is less than the 5% critical value of 4.026. So we have insufficient evidence at the 5% level to reject the null hypothesis. Therefore it is reasonable to conclude that $\sigma_A^2 = \sigma_B^2$.

(iii) To test whether the premiums charged by Company B are higher than those charged by Company A, we carry out a two-sample *t* test. We are testing:

$$H_0 : \mu_B = \mu_A \quad vs \quad H_1 : \mu_B > \mu_A$$

Under this null hypothesis, we use:

$$\frac{\bar{x}_B - \bar{x}_A}{\sqrt{s_P^2\left(\dfrac{1}{n_B} + \dfrac{1}{n_A}\right)}} \sim t_{n_A + n_B - 2}$$

Substituting in the values, we get a test statistic of:

$$\frac{225.9 - 213.4}{\sqrt{\dfrac{9 \times 4303.4 + 9 \times 3461.7}{18}\left(\dfrac{1}{10} + \dfrac{1}{10}\right)}} = 0.4486$$

Comparing this with the t_{18} values gives a *p*-value of in excess of 30%. So we have insufficient evidence to reject our null hypothesis at the 30% level. Therefore it is reasonable to conclude that the level of premiums charged by Company B is the *same* as that charged by Company A.