Srm - 1 Assignment 2

1) We need graduation to smooth the mortality rate & to reduce sampling errors. Also, in real life, irregularities in mortality rate is hard to justify & smooth rates are easier for calculation. Graduation generally struggles to strike right balance between smoothness & adherence to data.

2) The aim is to produce smooth set of rates that are suitable for a particular purpose, removing random sampling errors & to use information available from adjacent ages. The features are smoothness, data adherence & suitablity for the purpose to hand.

3) i) to make data easier for financial calculations
& to reduce sampling errors.

ii) 1) parametric formula
2) reference to standard table
3) spline functions.

iii) chi-square statistic = $\sum \frac{(O-E)^2}{E}$.

$= \frac{(248-227.28)^2}{227.28} + \frac{(392-367.55)^2}{367.55} + \frac{(680-672.13)^2}{672.13}$.

$+ \ldots + \frac{(925-891.36)^2}{891.36} + \frac{(130-155.48)^2}{155.48}$.

$= 14.3848..$

degrees of freedom = $9-1 = 8$

$\chi^2_8(0.05) = 15.51$; as test statistic is less than critical values, we fail to reject null hypothesis that graduated deaths are good fit to actual deaths.

iv) 1) Standardized deviations test :-

	$(-\infty,-3)$	$(-3,-2)$	$(-2,-1)$	$(-1,0)$	$(0,1)$	$(1,2)$	$(2,3)$	$(3,\infty)$
actual	0	1	0	1	2	4	1	0
expected	0	0.18	1.26	3.06	3.06	1.26	0.18	0
$(O-E)^2/E$	0	3.736	1.26	1.3867	0.367	5.5	3.736	0

$= 19.8117$ = test statistic.

degrees of freedom = 8.

~~it fails~~ enough evidence to reject the null hypothesis.

2) Cumulative deviation test.

test statistic = $\frac{\text{sum of actual deaths} - \text{sum of ex. de}}{\sqrt{\text{Sum of ex. deaths}}} \sim N(0,1)$

$= \frac{7931 - 7743.86}{\sqrt{7743.86}} = 2.1266$

two-sided test so critical value = ± 1.96

test statistic greater so we reject null hypothesis

v)

4) a) crude data vs standard data.

actual deaths vs deaths acc. to standard dat

actual	87	84	101	112	123	110	108	122	150	139	151
standard	102.65	107.3165	114.105 42	114.74 82	123.47 52	125.6 44	128.16 64	134.97 192	136.20 03	136.5 51	137.59 28
~~statistic~~	~~2.385 996~~	5.863 043	1.505 204	0.065 878	1.8258 29x10	1.947 542	3.173 740	1.246 709	1.398 174	0.035 746	1.547 652

~~test statistic = 18.969~~

~~degrees of freedom = 11 − 1 = 10~~

~~critical value =~~

test statistic = $\frac{1287 - 1363.52403}{\sqrt{1363.52403}}$

$= -2.07423$

∴ reject null hypothesis ; not fit.

5) i) a) there is a need to balance between smoothing & adherence to data. We need to avoid over or under graduating so as to it being representative of the actual data.

b) it removes the random sampling errors which means it gets ~~better~~ more good rates

ii)

245	276	313	323	339
224.501147	252.501 2494	283.614 578.	318.5617 064	357.815 0371
1.814910 235	2.18658 5337	3.044655 548	0.0618355 869	0.989353 6726

$= 8.09976$ ..

critical value $(df = 3) = 7.815$.

∴ we reject null hypothesis, not good fit.

6) a) the crude rates has to increase with age which is not the case so it may not be suitable.

b) ~~cumulative~~ standardised deviations test.

$(-\infty, -3)$	$(-3, -2)$	$(-2, -1)$	$(-1, 0)$	$(0, 1)$	$(1, 2)$	$(2, 3)$	$(3, \infty)$
0	0	1	1	5	2	0	0
0	0.18	1.26	3.06	3.06	1.26	0.18	0
—	0.18	0.053507	1.38679	1.229934	0.43 4603	0.18	—

$= 3.464977$.

$(df = 8) \Rightarrow 14...$

we fail to reject null hypothesis, good fit.

7) $m_{at} = \alpha_a + \beta_a \gamma_t + \epsilon_{at}$.

m_{at} = log of mortality rate in age group

α_a, β_a & γ_t are parameters to be estimated

ϵ_{at} random disturbances.

8) predicts based on simple expectations. fitting deterministic functions.

9) (a) test statistic = 2.2949

df = 10 ∴ fail to reject null hypothesis

(b) test statistic = $\frac{491 - 599.13}{\sqrt{599.13}} = -4.41$

reject null hypothesis.

14) (i) Undergraduation is when data is not smooth enough & oversgraduation is when data is too smooth & does not achese the data,

(ii) 2 4 5 7 8 9 9 5

1.95 2.55 3.55 5.94 7.2 8.25 8.05

0.97 1.44 1.69 3.7

5.4

= 4.06597449

df = 7

fail to reject null hypothesis.