Model Answer Probability 2001

p^2q^5 FHK

This question boils down to determining the distribution of the total score when four dice are thrown. All those who attempted the ML-based problem – Exercise II 4 – in the course handout should find it straightforward. A basic approach is to evaluate the generating function $\frac{(1\eta^0+1\eta^1+1\eta^2+1\eta^3+1\eta^4+1\eta^5+1\eta^6)^4}{6^4}$

To do this ...

1 1 1 1 1 1
1 1 1 1 1 1
1 1 1 1 1 1
1 1 1 1 1 1
1 1 1 1 1 1
1 1 1 1 1 1

1 2 3 4 5 6 5 4 3 2 1
1 2 3 4 5 6 5 4 3 2 1
1 2 3 4 5 6 5 4 3 2 1
1 2 3 4 5 6 5 4 3 2 1
1 2 3 4 5 6 5 4 3 2 1
1 2 3 4 5 6 5 4 3 2 1

1 3 6 10 15 21 25 27 27 25 21 15 10 6 3 1
1 3 6 10 15 21 25 27 27 25 21 15 10 6 3 1
1 3 6 10 15 21 25 27 27 25 21 15 10 6 3 1
1 3 6 10 15 21 25 27 27 25 21 15 10 6 3 1
1 3 6 10 15 21 25 27 27 25 21 15 10 6 3 1
1 3 6 10 15 21 25 27 27 25 21 15 10 6 3 1

1 4 10 20 35 56 80 104 125 140 146 140 125 104 80 56 35 20 10 4 1 ← $P(\text{total} = t) * 1296$
4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 ← t

$P(\geq 20 \text{ marks overall}) = \frac{35+20+10+4+1}{1296} = \frac{70}{1296} \approx \frac{1}{185}$ [12 marks]

Reduce threshold to 16 when ... ← [5 marks]

$P(\geq 16) = \frac{125+104+80+56+35+20+10+4+1}{1296} = \frac{435}{1296}$ ← [1 mark]

Note $\frac{432}{1296} = \frac{1}{3}$

With conventional assessment good candidates tend to perform well on all four papers – their four scores are not independent. It is now more reasonable to assume 20 as the threshold but one should expect still to lower it a little. [2 marks]