Are we ready for sheep genomic evaluation?

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Evaluation background

- 2008. Creation of Sheep Ireland: Within-breed Growth, Lambing, Litter size evaluation modules

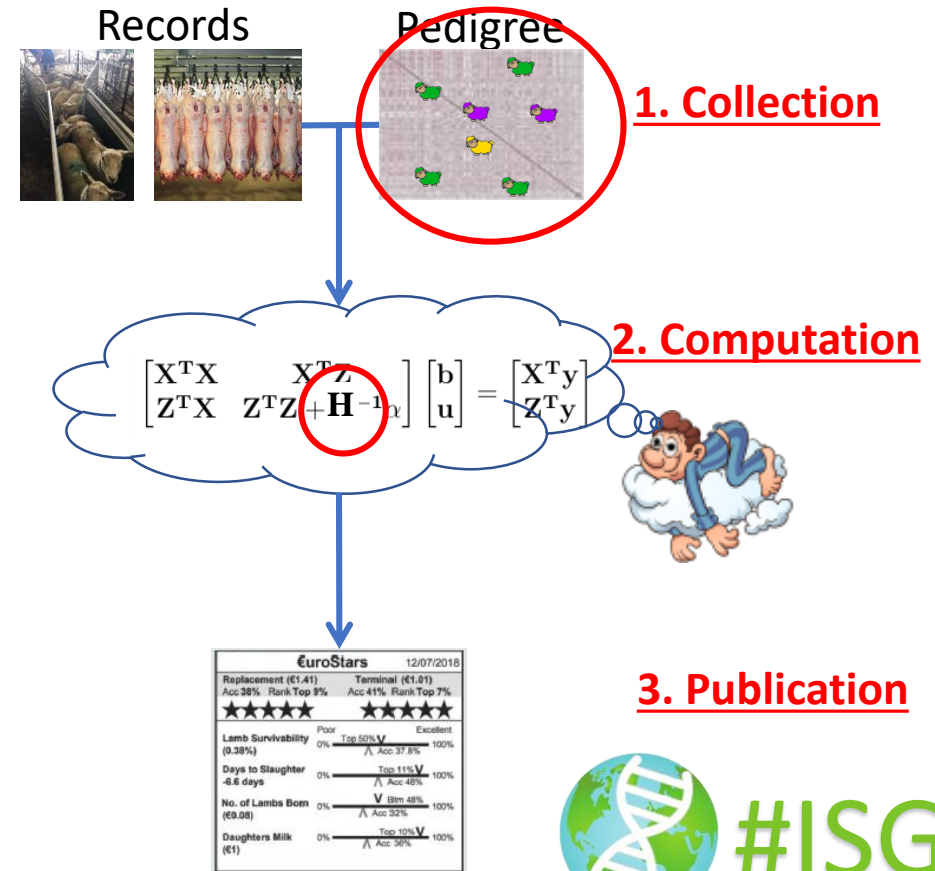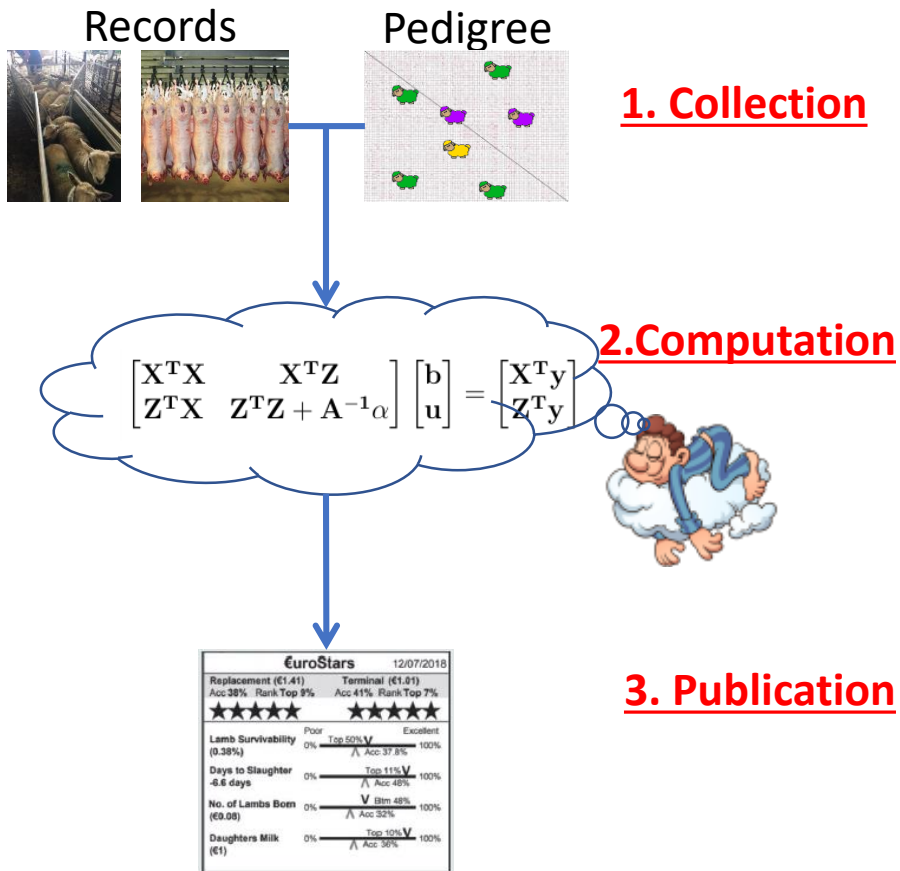- 2009. Establishment of the central progeny testing farms

recordings and more recordings, database upgrade, module & web-screens updates, and more

- 2016. Health module

- 2017. Update lambing module

- 2019. Update growth module + Across-breed evaluation

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Genetic and Genomic evaluation?

Genetic evaluation

Records   Pedigree

1. Collection

$$\begin{bmatrix} X^TX & X^TZ \\ Z^TX & Z^TZ + A^{-1}\alpha \end{bmatrix} \begin{bmatrix} b \\ u \end{bmatrix} = \begin{bmatrix} X^Ty \\ Z^Ty \end{bmatrix}$$

2. Computation

3. Publication

Genomic evaluation

Records   Pedigree

1. Collection

$$\begin{bmatrix} X^TX & X^TZ \\ Z^TX & Z^TZ + H^{-1}\alpha \end{bmatrix} \begin{bmatrix} b \\ u \end{bmatrix} = \begin{bmatrix} X^Ty \\ Z^Ty \end{bmatrix}$$

2. Computation

3. Publication

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Genomic evaluation pedigree

- Combining genotyped & non-genotyped animal pedigrees

Founders

Non-genotyped animals (n~780,000) – genetic pedigree

Genotyped animals (n=34,172) – genomic pedigree

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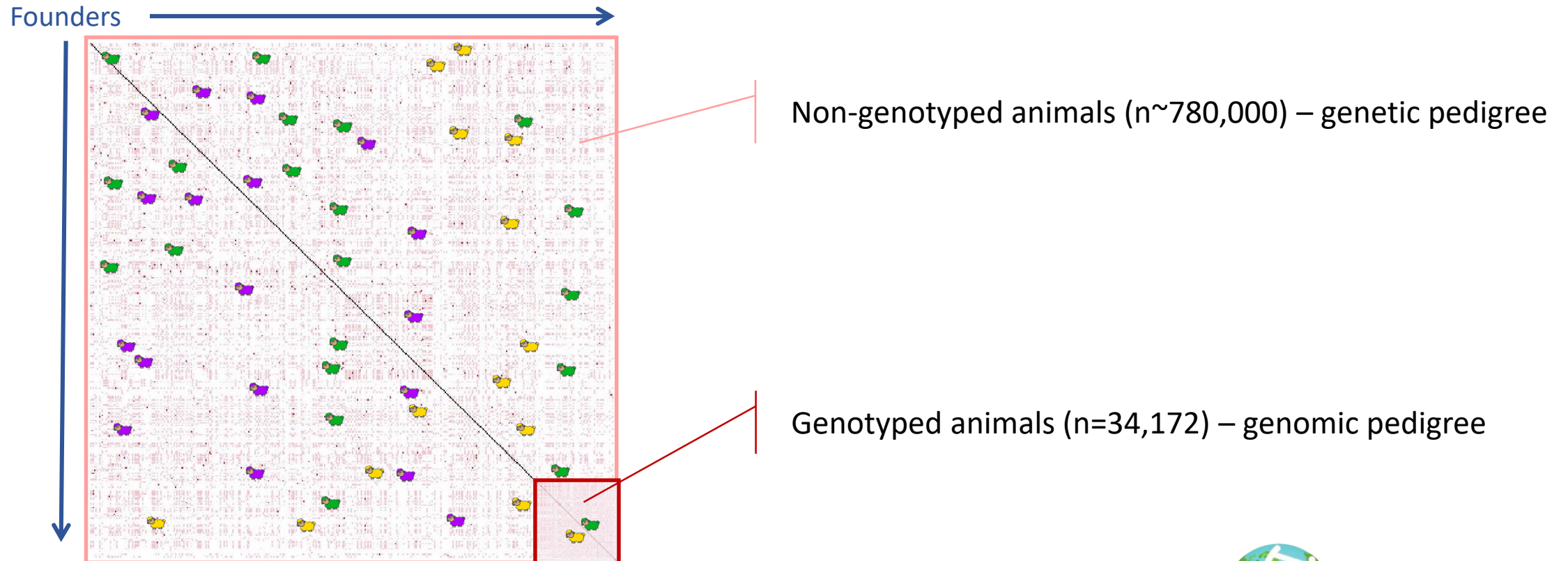
Genomic evaluation process

- Same everything but with a genomic evaluation pedigree

Growth	**Lambing**	**Health**	**Litter size**
Goal traits:	Goal traits:	Goal traits:	Goal traits:
• Days to slaughter	• Lambing ease	• Dag score	• Number of lambs born
• Carcass quality	• Lamb survival	• Lamb & ewe lameness	
• Ewe mature weight			

- Time to compute the breeding values

Genetic	29m27s
Genomic	**10h30m27s**

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Assessing the impact of genomics

- 2 questions to answer

Q1: Is the evaluation better?

= Model validation
= **Can the (ram) breeding values better predict future (progeny) performances**

Q2: Are the breeding values better?
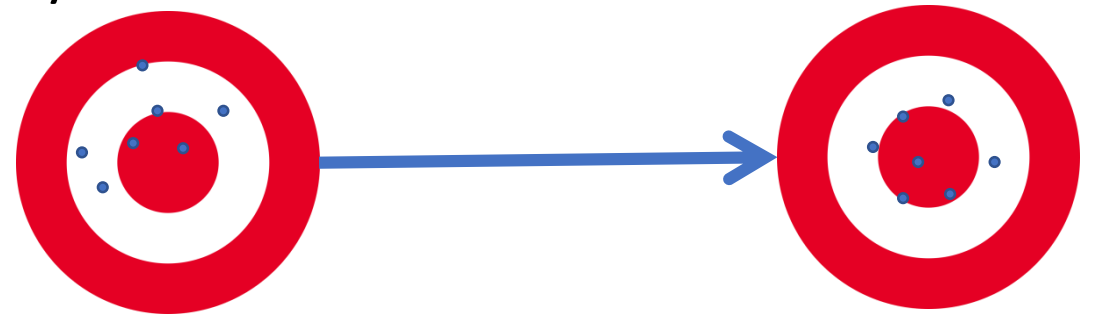

Adding ingredients to the evaluation
↳ **Are breeding values more accurate?**
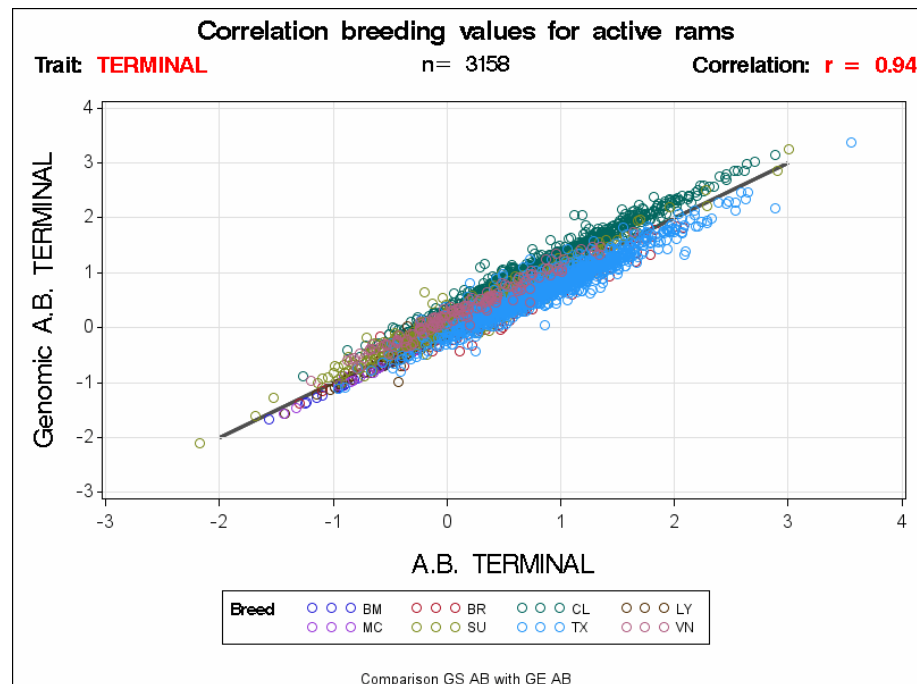↳ **Some level of re-ranking expected?**

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Q1: Model validation

- Validation study using commercial data

- Results presented at the Sheep Ireland Technical Advisory Group
  - October 2019 & January 2020
  - Genomics ⇨ Better model prediction (less bias)
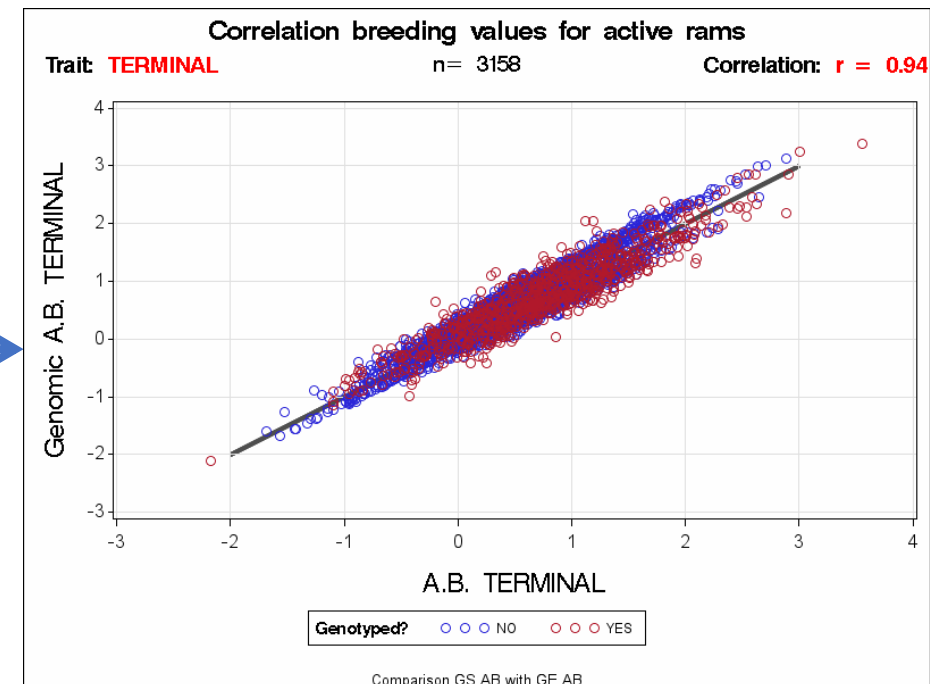 - Genomics ⇨ Better prediction accuracy

Overall breeding values

- Strong correlation between genetic & genomic proofs

Strong within-breed correlation

Non-genotyped animals also benefits from genomics

- Similar picture for Replacement Index

Accuracy of breeding values

- Huge gain in accuracy for genotyped animals

Average gain in accuracy for genotyped 2019 pedigree ram lambs

	#lamb rams	**Terminal**	**Replacement**
Belclare	854	+15%	+17%
Charollais	533	+13%	+16%
Lleyn	54	+11%	+12%
Suffolk	775	+17%	+20%
Texel	1065	+15%	+18%
Vendeen	80	+16%	+18%

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Gain in accuracy in terms of progeny

- Converting the accuracy gain to equivalent progeny with records

Trait	h^2	Gain in accuracy from genomics Average (Max)	Equivalent number of progeny with record Average (Max)
Litter size	7%	+0.24 (+0.51)	+4 (+19)
Ewe weight	23%	+0.19 (+0.50)	+1 (+6)
Lamb survival	2%	+0.26 (+0.45)	+14 (+51)
Days to slaughter	25%	+0.16 (+0.52)	+1 (+6)
Dag score	12%	+0.15 (+0.47)	+1 (+10)
Weaning weight	22%	+0.15 (+0.54)	+1 (+7)

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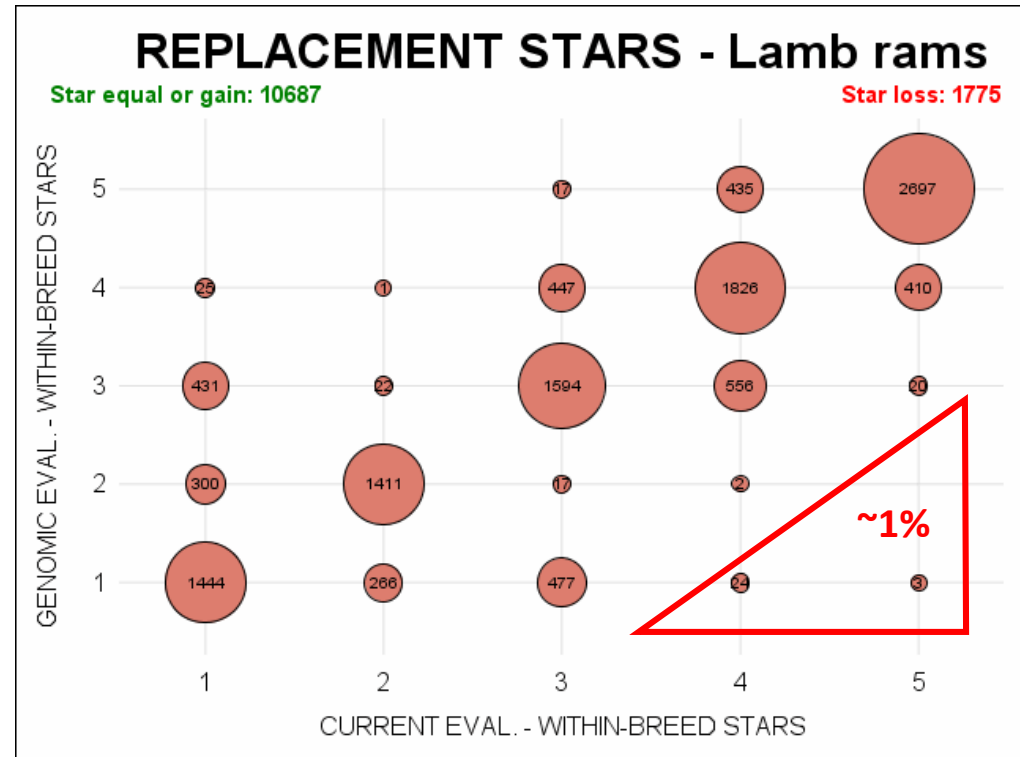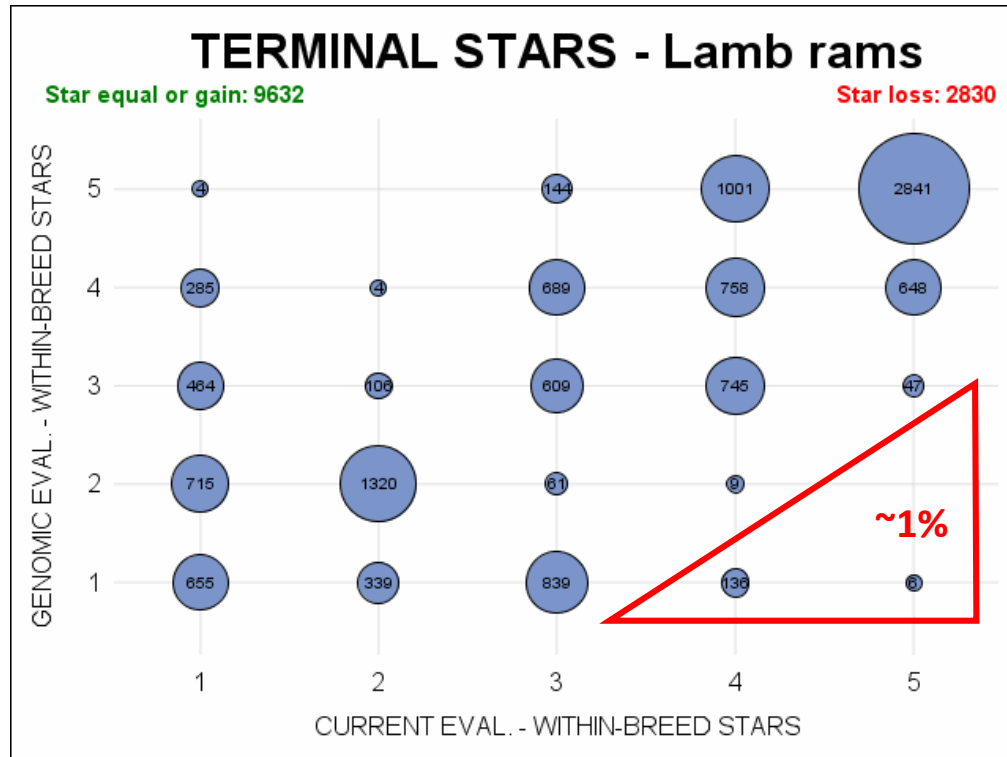# Genomics & Stars

- Validation: differences in progeny performance from 1★ & 5★ mating

Index	Trait	Mating type			Genomic added difference	
		★	★★★★★	Difference		
Replacement	Lamb mortality (%)	10.65	9.45	**-1.20**	-0.18 = **-1.38**	**+15%**
	Litter size	1.92	1.97	**+0.05**	+0.01 = **+0.06**	**+20%**
	Ewe mature weight (kg)	78.20	76.80	**-1.90**	-1.01 = **-2.91**	**+53%**
Terminal	Lambing difficulty (%)	23.06	18.17	**-4.90**	-1.60 = **-6.50**	**+32%**
	Days to slaughter (days)	197	182	**-15**	-0.80 = **-15.8**	**+5%**

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Star movements

• More star gain than star loss*

Ex. Ram IE04   52D

- Genetic evaluation

Oh yeah!

Used in 1 CPT flock
37 progenies / 2 years

0.50

Terminal acc. 53%
Replace. acc. 64%

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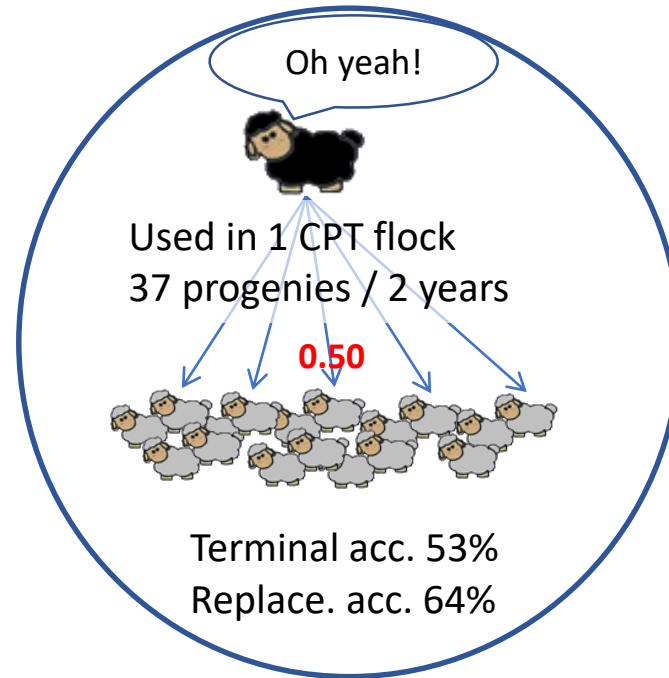
Conclusion

- Genomic evaluation = more accurate breeding values

- Sheep Ireland is ready to implement genomic evaluations
  - Evaluation process are in place
  - Non-genomic evaluation can still be ran in the background to help explain changes

- **Genomic evaluations are coming for 2020!**

Thank you for your attention.

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