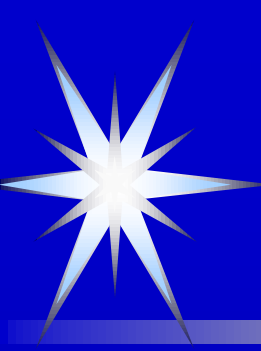




**Applying detection controls
in assessing variance in
feedlot cattle performance**

Richard Zinn

University of California, Davis



Observed vs Expected

- Every purposeful observation has:
 - rational expectations
 - rational limits
- What we “see” or “perceive” is nested in
 - concepts
 - experience
 - experimental abstractions

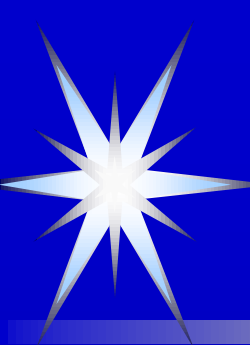


How much will an observation deviate from expected before we experience

➤ Surprise

➤ Concern

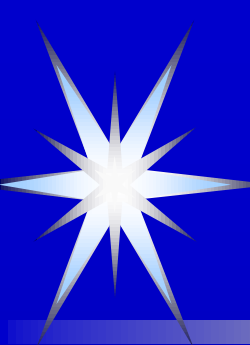
➤ Alarm!



Example: medium-frame English-cross calves,
late finishing phase (last 112 days)

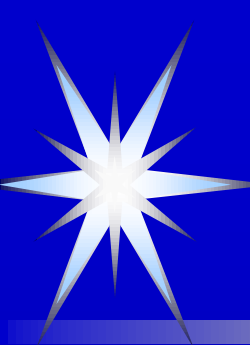
	“Observed”	Expected ?
Initial weight, kg	400	
Final weight, kg	546	
ADG, kg	1.33	
DMI, kg/d	6.05	
DMI/ADG	4.45	

Diet NEm, 2.15 Mcal/kg



Example: medium-frame calves,
late finishing phase (last 112 days)

	Observed 1 st look	Observed 2 nd look
Initial weight, kg	400	400
Final weight, kg	546	546
ADG, kg	1.33	1.33
DMI, kg/d	6.05	7.56
DMI/ADG	4.45	5.68

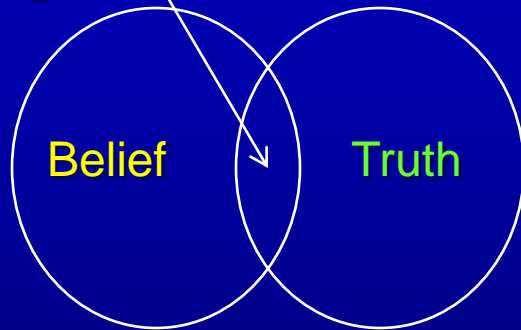


Example: medium-frame calves,
late finishing phase (last 112 days)

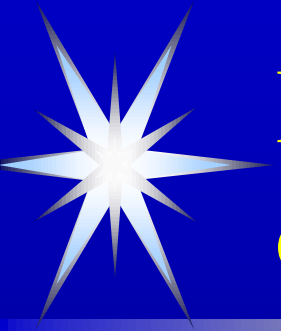
	Observed 1 st look	Observed 2 nd look	Expected
Initial weight, kg	400	400	400
Final weight, kg	546	546	546
ADG, kg	1.33	1.33	1.36
DMI, kg/d	6.05	7.56	7.60
Exp/Obs DMI	1.26	0.985	1.00
DMI/ADG	4.45	5.68	5.59

What do we “*know*” in terms of expectations??

- Knowledge is the intersect between the independent domains of belief and truth

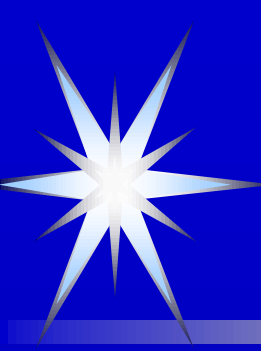


- Sense of certainty is part of a “belief continuum” dependent on:
 - Repeatability
 - Relative risk



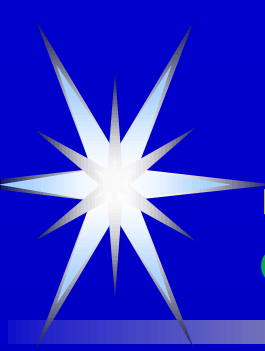
How well do current nutritional concepts apply????

Relationships between energetics and growth-performance...**more reliable**



Expectations.....to believe that

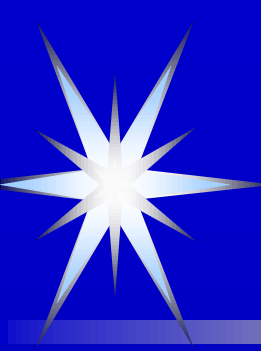
- ADG and DMI of feedlot cattle are predictable functions of:
 - Gender
 - Quality score/ frame
 - QS increasing inversely with frame size
 - Shrunken initial weight
 - Average shrunken live weight for period of interest
 - Dietary NEm and NEg (Mcal/kg)



Standards/ “expectation” references

(Zinn et al., 2008)

- **MFWsteer**, kg = $509.6 + 0.4697 \text{ SIW} - 46.54 \text{ PQS}$,
- **MFWheifer**, kg = $551.5 - 0.2482 \text{ SIW} + 0.00119 \text{ SIW}^2 - 39.84 \text{ PQS}$,
- **ADGsteer**, kg = $1.628 + 0.00287 \text{ SIW} - 0.00000107 \text{ SIW}^2 - 0.461 \text{ PQS}$,
- **ADGheifer**, kg = $1.265 + 0.00432 \text{ SIW} - 0.00000425 \text{ SIW}^2 - 0.410 \text{ PQS}$
- **PQS** (frame) = $2 + (\text{ADG}_{\text{MQ predicted}} - \text{ADG}_{\text{observed}}) / (0.30 \text{ ADG}_{\text{MQ predicted}})$
- **DMIsteer**, kg = $(0.0606 * ((\text{SLW} * 478 / \text{MFW})^{0.75}) * \text{ADG}^{0.905}) / \text{NEg} + (0.077 \text{ LW}^{0.75} / \text{NEm})$,
- **DMIheifer**, kg = $(0.0618 * ((\text{SLW} * 478 / \text{MFW})^{0.75}) * \text{ADG}^{0.905}) / \text{NEg} + (0.077 \text{ LW}^{0.75} / \text{NEm})$
- **DMI_{peak}**, kg = $(12.7 + 0.0402 \text{ SIW} - 1.02 \text{ Gender} - 2.63 \text{ PQS}) / \text{NEm}$



Helpful parametrizations

- $\text{Mature weight}_{\text{kg}} = 550 + 0.5 \text{ IW} - 50 \text{ Gender} - 50 \text{ PQS}$
- (If Fleshy on arrival increase PQS by 0.5)
- $\text{ADG}_{\text{kg}} = 1.85 + 0.0022 \text{ IW}_{\text{kg}} - 0.45 \text{ PQS} - 0.15 \text{ Gender}$
- $\text{DMI} = (14 + 0.03 \text{ IW}_{\text{kg}} - 2 \text{ PQS} - .5 \text{ Gender})/\text{NEm}$
- $\text{Peak intake weight (PIW)} = \text{IW}_{\text{kg}} + (23,000/\text{IW}_{\text{kg}})$
- $\text{Peak DMI} = (12.5 + .04 \text{ IW}_{\text{kg}} - 1 \text{ Gender} - 2.5 \text{ PQS})/\text{NEm}$
- $\text{Fat thickness (FT, cm)} = 0.02 \text{ cm/kg ADG during the finishing phase}$
- $\text{Yield grade increases by } .018 \text{ units/kg ADG during finishing phase}$
- $\text{Ribeye area (REA cm}^2\text{)} = 0.2 \text{ cm}^2/\text{kg ADG during the finishing phase}$



What can we expect of a **365** kg yearling steer, where **VQS = 2.2** and diet **NEm = 2.16** Mcal/kg?

Visual QS	2.2
Shrunk IW, KG	365
Shrunk FW, KG	573
ADG, KG	1.51
Days on feed	137
DMI, KG/D	9.0
DMI _{PEAK} , KG	9.5
DMI/ADG	6.0



Performance evaluation

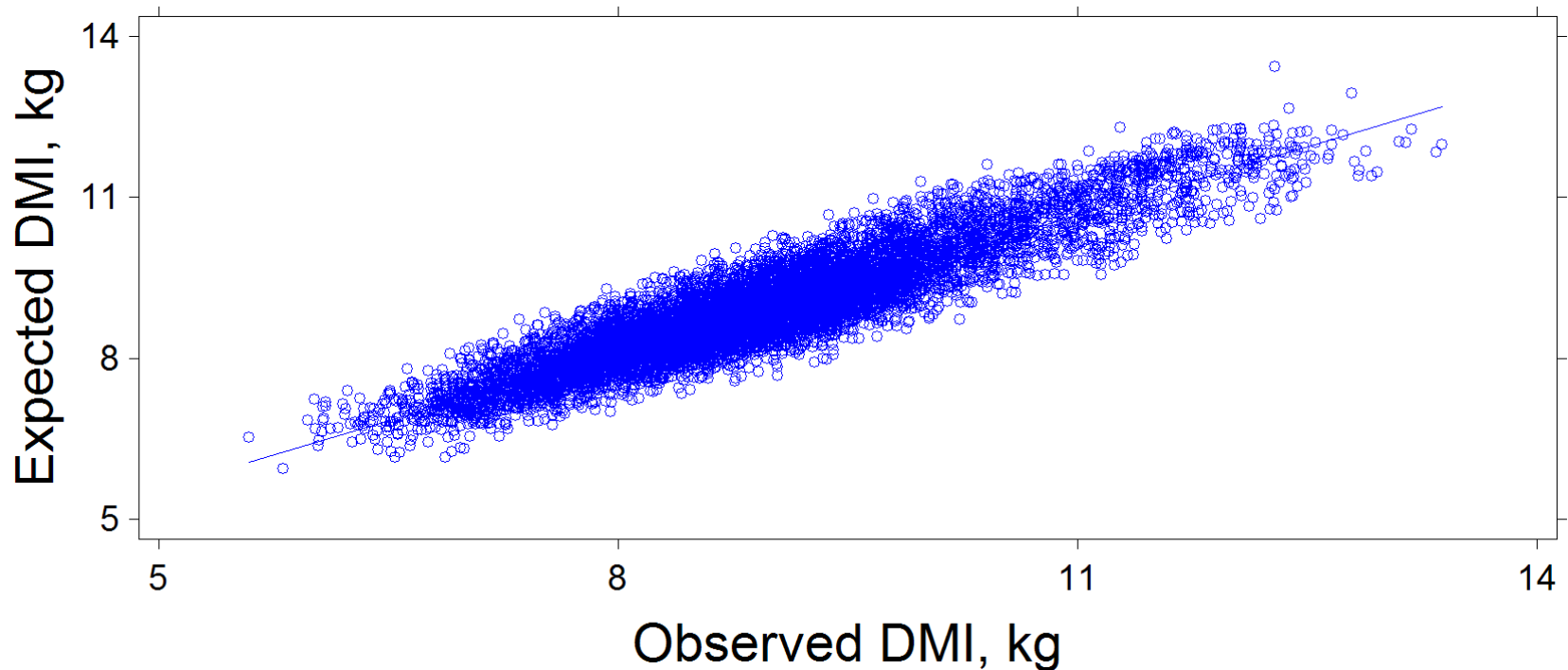
➤ Feed efficiency and ADG

- Most commonly evaluated performance factors
- Confound by:
 - Initial weight
 - Frame/mature weight
 - Harvest weight:mature weight ratio
 - Dietary energy density limits usefulness
- Can be very misleading in terms of management controls

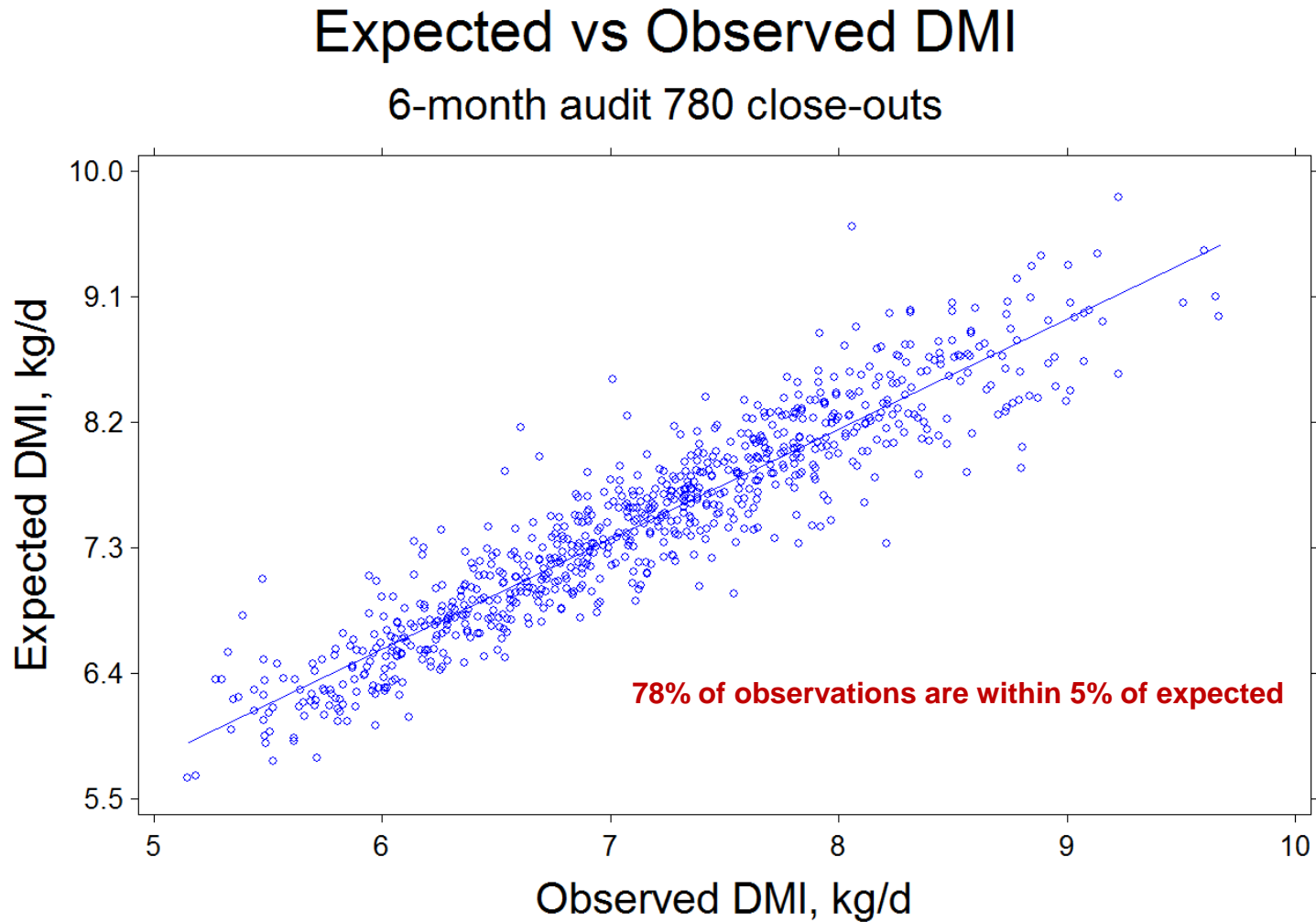
ADG and DMI are predictable functions

Observed vs expected DMI

Based on ADG and dietary NE



Assessing variation in DMI





The coefficients of variation is lower for measures of “variance ratio”

Single feedlot, (6-month data summary) 780 close-outs

Item	CV, %
ADG	12.0
Feed/gain	10.4
Variance ratio	
Expected/Observed DMI	4.9

How can we apply standards to generate “expectations”?



$\text{MFW}_{\text{steer}}, \text{kg} = 509.6 + 0.4697 \text{ SIW} - 46.54 \text{ PQS},$

$\text{MFW}_{\text{heifer}}, \text{kg} = 551.5 - 0.2482 \text{ SIW} + 0.00119 \text{ SIW}^2 - 39.84 \text{ PQS},$

$\text{ADG}_{\text{steer}}, \text{kg} = 1.628 + 0.00287 \text{ SIW} - 0.00000107 \text{ SIW}^2 - 0.461 \text{ PQS},$

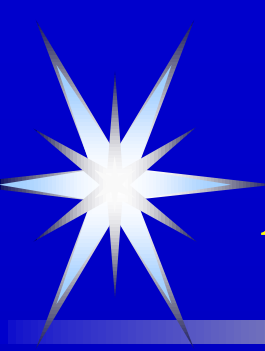
$\text{ADG}_{\text{heifer}}, \text{kg} = 1.265 + 0.00432 \text{ SIW} - 0.00000425 \text{ SIW}^2 - 0.410 \text{ PQS}$

$\text{PQS (frame)} = 2 + (\text{ADG}_{\text{MQ predicted}} - \text{ADG}_{\text{observed}}) / (0.30 \text{ ADG}_{\text{MQ predicted}})$

$\text{DMI}_{\text{steer}}, \text{kg} = (0.0606 * ((\text{SLW} * 478 / \text{MFW})^{0.75}) * \text{ADG}^{0.905}) / \text{NEg} + (0.077 \text{ LW}^{0.75} / \text{NEm}),$

$\text{DMI}_{\text{heifer}}, \text{kg} = (0.0618 * ((\text{SLW} * 478 / \text{MFW})^{0.75}) * \text{ADG}^{0.905}) / \text{NEg} + (0.077 \text{ LW}^{0.75} / \text{NEm})$

$\text{DMI}_{\text{peak}}, \text{kg} = (12.7 + 0.0402 \text{ SIW} - 1.02 \text{ Gender} - 2.63 \text{ PQS}) / \text{NEm}$



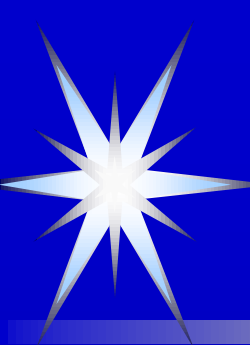
Auditing performance





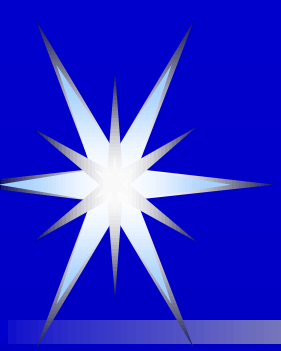
Sources of apparent performance variation

- Inaccurate measure of diet DM
- Inaccurate assessment of diet NE
- Error in classification of gender and quality
- Improper or poor weighing conditions
- Recording errors
- Cattle transferences/mixing
- Environmental stressors



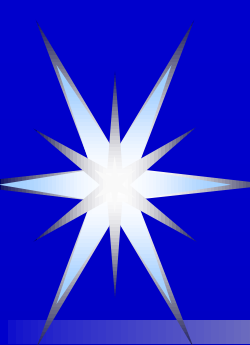
First challenge: Data collection

PEN	SEX	MIN	MOUT	PAYWT	INWT	SIW	FSW	YLDOUT	DOF	ADG	FG	DMI	DM%	NEm	YIELD	PCTCH
P13	1	9	2	1054	1026	1011.84	1389	1403	126	2.77	7.72	21.38	80.9	2.10	62.62	33.8
O1	1	12	5	881	870	845.76	1368	1335	135	3.36	6.14	20.64	81.0	2.10	63	25.67
N11	1	1	6	815	801	782.4	1316	1280	147	3.16	5.98	18.92	80.9	2.10	62.81	43.66
E12	2	6	10	811	782	778.56	1164	1183	128	2.91	6.19	17.98	81.0	2.10	63.02	63.96
M11	1	10	5	671	645	644.16	1279	1242	191	2.99	5.61	16.76	81.0	2.10	62.69	31.27
F6	2	8	1	799	788	767.04	1207	1241	141	3.13	6.02	18.87	80.9	2.10	63.75	56.88
M10	1	10	2	1015	1000	974.4	1495	1446	116	3.72	6.44	23.93	80.9	2.10	62.44	47.67
N11	1	9	4	737	711	707.52	1321	1352	206	2.99	6.27	18.71	81.0	2.10	63.46	53.95
M9	1	5	9	858	858	823.68	1331	1344	134	3.63	5.86	21.26	81.0	2.10	62.59	72.52
N10	1	1	6	704	703	675.84	1297	1322	176	3.51	5.36	18.81	81.0	2.10	63.21	31.34
M10	1	9	2	717	685	688.32	1285	1245	169	3.12	5.91	18.47	81.0	2.10	62.57	48.18
P11	1	10	4	693	667	665.28	1258	1211	181	2.86	5.04	14.43	81.0	2.10	62.17	35.81
M11	1	8	1	908	885	871.68	1356	1342	133	3.26	6.85	22.36	80.9	2.10	61.36	75
M10	1	8	1	894	862	858.24	1291	1316	139	3.04	6.97	21.17	81.0	2.09	63.17	78.71
B10	2	7	1	930	883	892.8	1346	1349	123	3.41	6.47	22.05	81.0	2.09	62.14	47.88
X4	2	9	4	677	656	649.92	1184	1210	207	2.57	6.8	17.5	81.0	2.10	63.38	63.12
M10	1	9	1	848	818	814.08	1310	1332	145	3.34	5.81	19.39	81.0	2.09	63.05	38.15
M10	1	11	5	653	642	626.88	1204	1215	191	2.94	5.82	17.12	81.0	2.10	62.55	26.36
M9	1	12	6	714	684	685.44	1375	1348	173	3.66	5.54	20.3	81.0	2.10	63.34	54.38
M9	1	2	6	880	842	844.8	1268	1272	121	3.24	6.39	20.69	81.0	2.09	62.2	51.85
P13	1	2	6	849	858	815.04	1287	1316	134	3.49	5.81	20.26	80.9	2.09	63.43	67.37
N10	1	1	6	826	791	792.96	1371	1338	147	3.48	5.85	20.37	81.0	2.10	63.05	38.43
P13	1	5	11	742	742	712.32	1358	1368	181	3.46	6.12	21.18	81.0	2.10	62.46	42.86
M12	1	1	7	765	749	734.4	1299	1323	160	3.49	5.33	18.59	81.0	2.10	63.13	39.51
M10	1	10	2	868	827	833.28	1386	1340	139	3.4	6.07	20.6	81.0	2.10	62.43	40.18
N11	1	10	3	856	825	821.76	1299	1270	140	2.96	5.93	17.55	81.0	2.10	63.17	51.35
N13	1	2	6	834	810	800.64	1395	1358	138	3.8	5.32	20.2	81.0	2.09	62.88	61.64
B13	2	5	9	854	833	819.84	1245	1258	125	3.23	6.44	20.8	81.0	2.10	62.64	43.43
P11	1	3	8	817	818	784.32	1351	1379	150	3.75	5.61	21.02	80.9	2.10	63.28	58.67
B9	2	6	10	788	782	756.48	1171	1206	136	3.07	6.17	18.96	81.0	2.09	63.86	43.75
X8	2	11	6	632	609	606.72	1121	1149	188	2.75	6	16.5	81.0	2.10	63.5	45.81
K9	1	2	8	777	746	745.92	1312	1331	159	3.48	5.65	19.7	81.0	2.09	62.88	53.18
A13	2	2	7	752	732	721.92	1158	1183	145	2.97	6.05	17.99	81.0	2.10	63.34	44.84
E8	2	5	11	684	641	656.64	1175	1203	172	3.02	6.11	18.44	81.0	2.10	63.5	64.69
O15	1	2	7	795	797	763.2	1274	1313	159	3.26	5.68	18.5	81.0	2.10	63.91	27.96
E8	2	9	2	782	760	750.72	1182	1195	153	2.7	6.91	18.64	81.0	2.10	62.7	67.06
P13	1	8	1	854	847	819.84	1379	1391	152	3.53	6.03	21.29	81.0	2.10	62.54	79.14
G9	2	11	5	761	731	730.56	1205	1208	165	2.71	6.73	18.24	81.0	2.09	62.15	59.3
H9	1	7	1	774	721	743.04	1216	1231	163	2.8	6.15	17.24	81.0	2.10	62.76	41.62
K13	1	4	10	802	754	769.92	1261	1280	144	3.32	6.08	20.19	81.0	2.09	62.79	24.53
N13	1	8	2	737	742	707.52	1192	1228	171	2.87	6.42	18.43	81.0	2.09	63.87	68.72
M8	1	4	8	884	859	848.64	1295	1304	122	3.44	6.07	20.88	81.0	2.09	62.46	54.79
A10	2	7	12	772	748	741.12	1112	1132	144	2.5	7.48	18.71	81.0	2.10	63.12	51.16
G8	1	5	10	802	766	769.92	1324	1355	150	3.69	5.69	20.99	81.0	2.09	63.45	61.77
M8	1	8	12	922	881	885.12	1172	1240	116	2.74	7.32	20.07	81.0	2.10	65.38	28.3



Second challenge: Concepts vs Conventions

PAYWT	INWT	SHRINK	SFW	CASFW
358	340	5.1	500	518
362	343	5.3	525	533
309	290	6.3	485	492
335	320	4.7	525	541
400	396	1.1	518	525
402	392	2.6	560	543
300	285	5.0	485	495
425	417	1.8	563	557
401	389	3.1	554	555
349	344	1.4	516	513
315	300	4.6	495	514
337	315	6.5	534	550
255	241	5.5	475	495



Third challenge: Data quality

DF1	KF1	DMF1	ENmF1	DF2	KF2	DMF2	NEmF2	DF3	KF3	DMf3	NEmF3
13	4282	81.3	1.95	10	3872	81.2	2.09	124	63660	80.4	2.15
13	4676	81.3	1.95	10	3822	81.2	2.09	126	59831	80.4	2.15
10	4764	81.3	1.95	10	3840	81.2	2.09	142	72597	80.4	2.15
10	6146	81.3	1.95	10	6182	81.2	2.09	137	87124	80.4	2.15
12	5305	81.3	1.95	10	4246	81.2	2.09	138	64156	80.4	2.15
14	5756	81.3	1.95	10	4563	81.2	2.09	200	103928	80.4	2.15
10	5885	81.3	1.95	11	5842	81.2	2.09	147	99696	80.4	2.15
13	5098	81.3	1.95	11	4095	81.2	2.09	135	65168	80.4	2.15
10	4775	81.3	1.95	11	5054	81.2	2.09	134	71751	80.4	2.15
12	5171	81.3	1.95	11	4538	81.2	2.09	132	68649	80.4	2.15
8	4192	81.3	1.95	11	4822	81.2	2.09	132	68913	80.4	2.15
11	5439	81.3	1.95	11	5326	81.2	2.09	126	77687	80.4	2.15
10	4599	81.3	1.95	12	4852	81.2	2.09	160	79086	80.4	2.15
11	6492	81.3	1.95	12	8004	81.2	2.09	125	109367	80.4	2.15
9	4595	81.3	1.95	12	6009	81.2	2.09	131	66679	80.4	2.15
11	4011	81.3	1.95	12	3756	81.2	2.09	127	52989	80.4	2.15
10	5688	81.3	1.95	12	6714	81.2	2.09	128	85353	80.4	2.15
9	4212	81.3	1.95	12	4014	81.2	2.09	157	74940	80.4	2.15
9	3631	81.3	1.95	12	4171	81.2	2.09	132	62409	80.4	2.15
10	5141	81.3	1.95	13	5358	81.2	2.09	160	69596	80.4	2.15
9	4160	81.3	1.95	13	4969	81.2	2.09	105	56455	80.4	2.15
15	7291	81.3	1.95	13	6303	81.2	2.09	137	63042	80.4	2.15
12	7895	81.3	1.95	13	8426	81.2	2.09	132	119289	80.4	2.15
13	5749	81.3	1.95	13	6020	81.2	2.09	132	81859	80.4	2.15
10	4190	81.3	1.95	13	6559	81.2	2.09	135	84706	80.4	2.15
11	4180	81.3	1.95	13	4856	81.2	2.09	133	65119	80.4	2.15
10	4158	81.3	1.95	14	4843	81.2	2.09	124	57146	80.4	2.15



Before visual review of pen lots

- Review current close-out summary

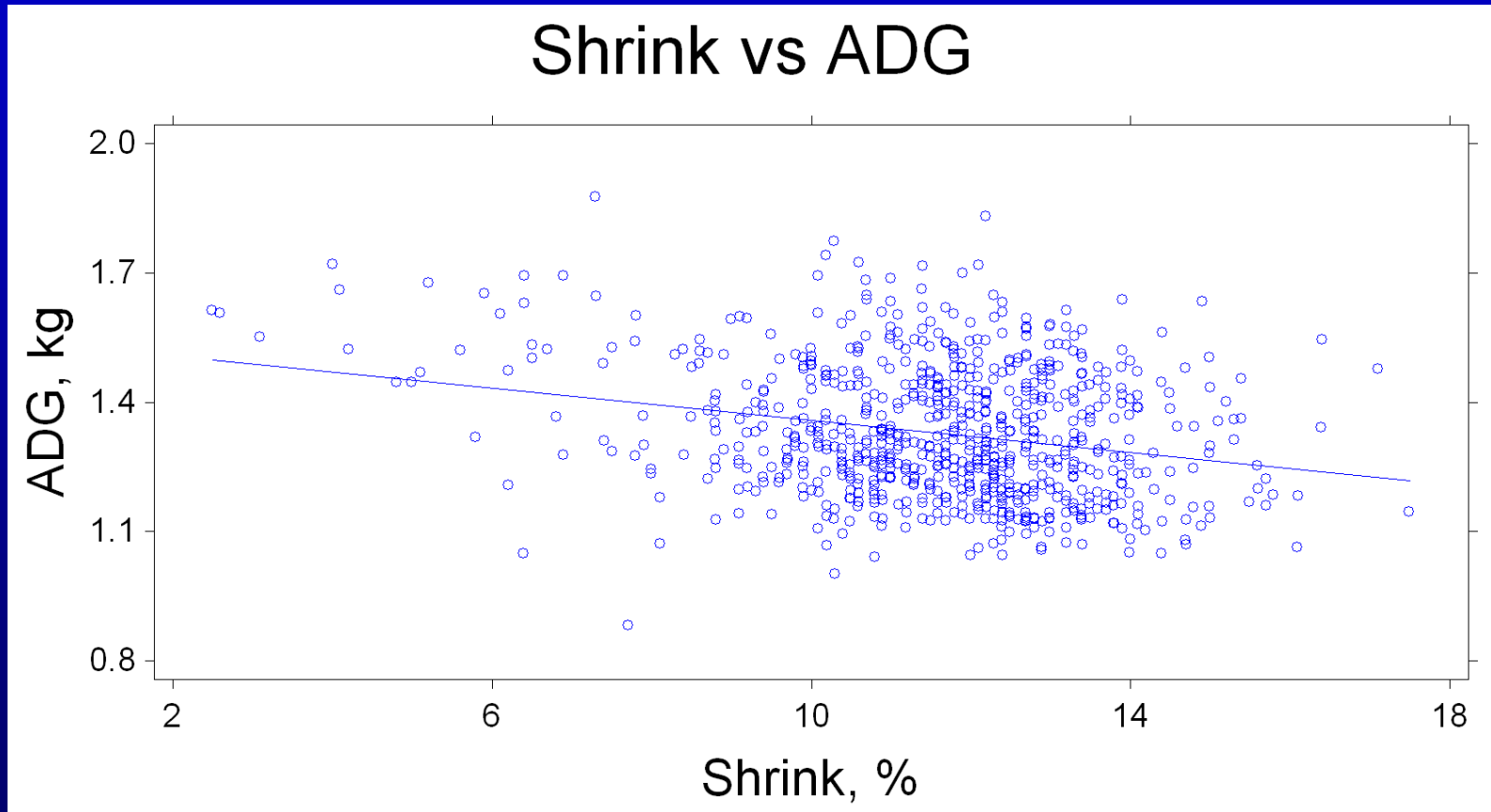
- Note:

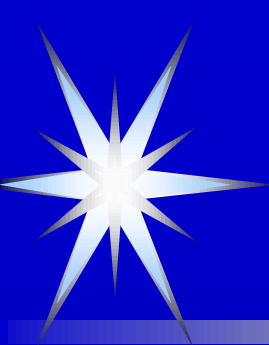
- Gender mix (proportion of steers and heifers)
 - Average in weight
 - Shrink
 - Predicted quality score (PQS/ Frame)
 - Preliminary ADG ratio (observed:expected ADG)
 - Preliminary DMI ratio (expected:observed intake)
 - Final weight ratio (observed:expected final weight)
 - Morbidity
 - Mortality

- Review diet composition and DM %



Shrink is a significant cause of performance variance





Beginning a growth performance audit

Actual close-out summary: 579 steers, 305 heifers

1.35	2.26	344.33	577.67	1.63	548.87	153.73	1.53	8.82	0.93
0.35	0.17	0.13	0.06	0.12	0.07	0.16	0.12	0.09	0.10

HEIFER
VQS

2.0

STEER
VQS

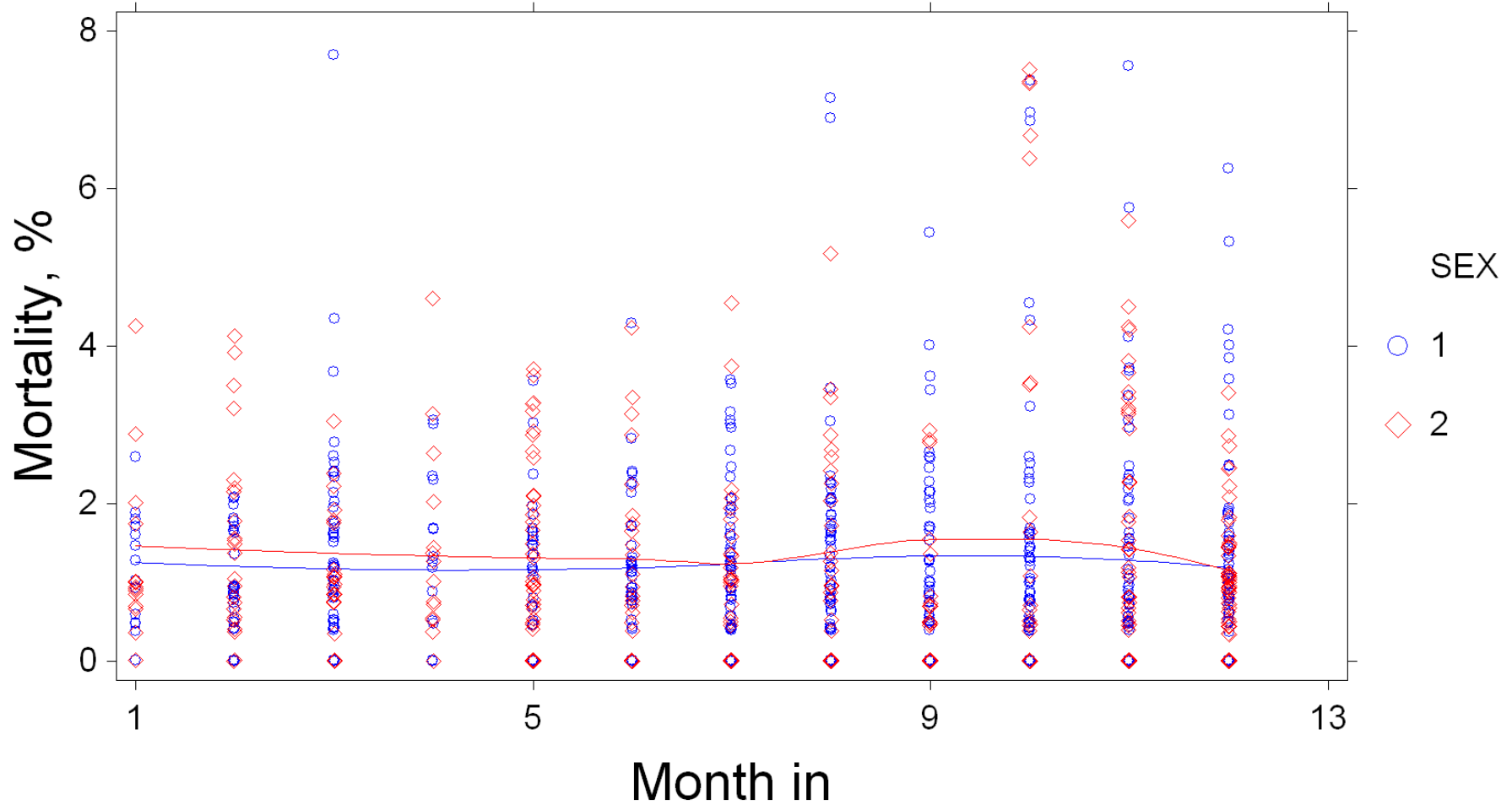
2.0


GENDER	FRAME	IW	FW	prdADG	FSBW	DOF	ADG	DMI	ADG Ratio
1	2.31	355.45	595.35	1.72	569.14	152.85	1.58	9.01	0.92
2	2.18	323.30	544.21	1.52	510.51	155.38	1.44	8.47	0.95

0.19	1.41	2.16	8.96	1.02	82.00	17.32	1.22	3.38	5.80
0.07	0.10	0.00	0.09	0.05	0.00	0.95	0.95	0.69	0.09

cof	cog	NM	EXPDMI	DMI RATIO	PDM	PMORB	DEATH	SHRINK	FG
0.19	1.39	2.16	9.14	1.02	82.00	17.85	1.19	1.19	5.67
0.19	1.45	2.16	8.62	1.02	82.00	17.95	1.27	3.51	5.73

Month of arrival versus mortality





Predictability of shrunk final weight based on purchase weight, frame and sex

Least Squares Linear Regression of Final shrunk weight

Predictor

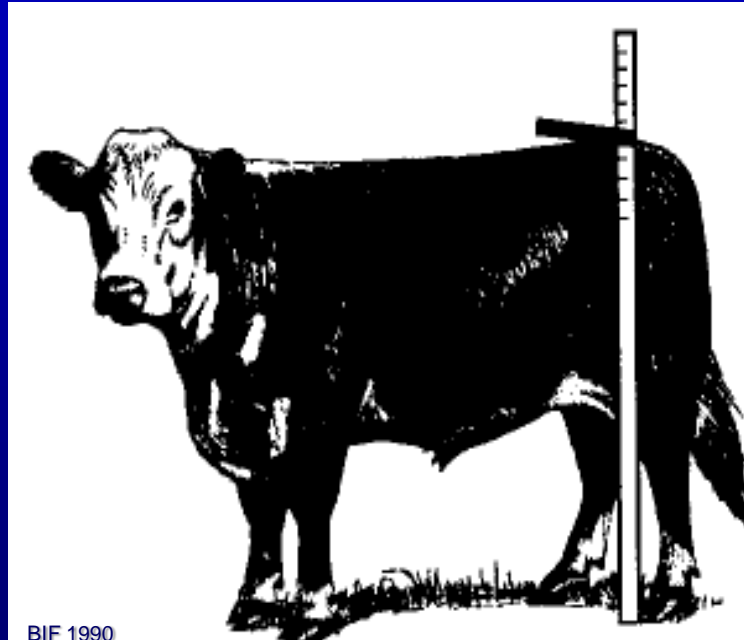
Variables	Coefficient	Std Error	T	P	VIF
Constant	538.361	3.17458	169.58	0.0000	0.0
Purchase weight	0.53525	0.00974	54.94	0.0000	1.6
PQS	-48.1292	1.47801	-32.56	0.0000	1.7
Gender	-52.3098	0.86353	-60.58	0.0000	1.0
R-Squared	0.8614	Resid. Mean Square (MSE)			132.972
Adjusted R-Squared	0.8610	Standard Deviation			11.5313
AICc	4979.3				
PRESS	136032				

Source	DF	SS	MS	F	P
Regression	3	836988	278996	2098.16	0.0000
Residual	1013	134700	133		
Total	1016	971688			

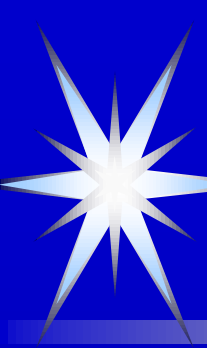
Cases Included 1017 Missing Cases 0

The next step: Quality score

- Visual assessment of performance quality (VQS)

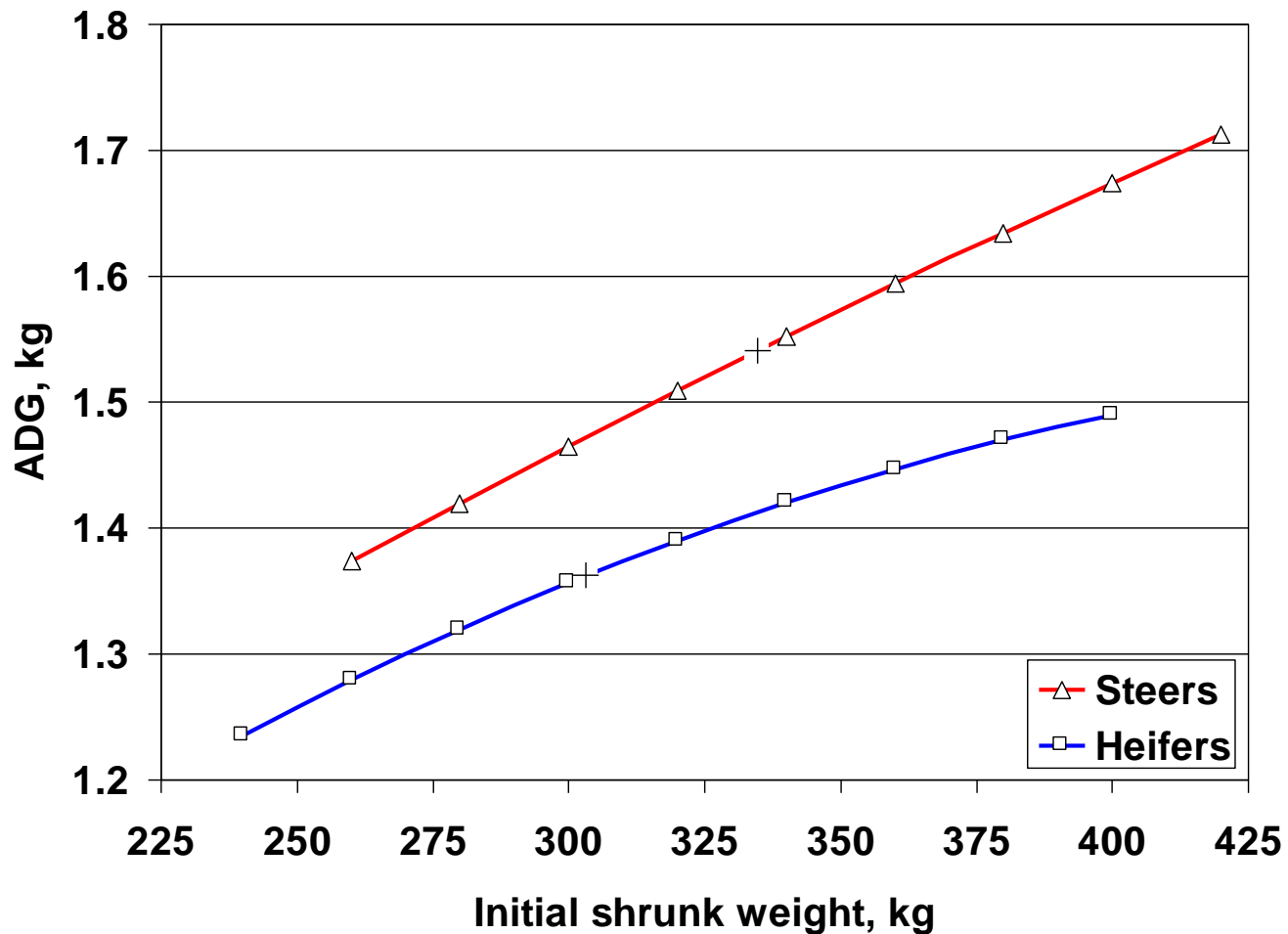


BIF 1990



ADG is also a predictable function of initial weight

Average daily gain predicted from initial shrunk weight of steers ($ADG = 0.72 + 0.0029 SIW - 0.00000142 SIW^2$; $r^2 = 0.25$; $S_{xy} = 0.147$; $P < 0.001$) and heifers ($ADG = 0.5015 + 0.004027 SIW - 0.00000397 SIW^2$; $r^2 = 0.22$; $S_{xy} = 0.127$; $P < 0.001$) at commercial feedlots (the "+" symbol identifies the gender mean).

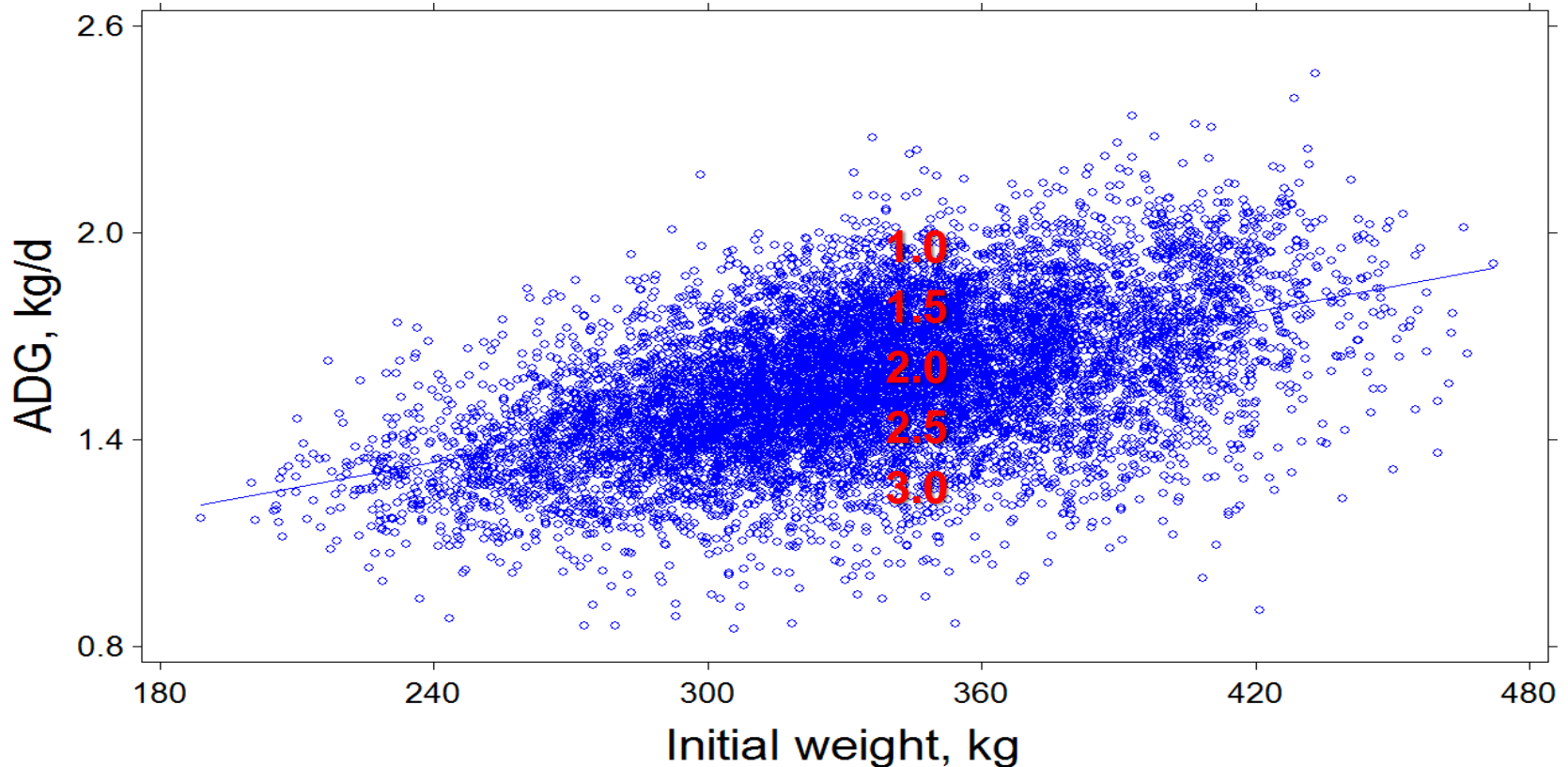




Assessing variation in cattle performance: ADG

Initial weight vs ADG

9,683 steer close-outs





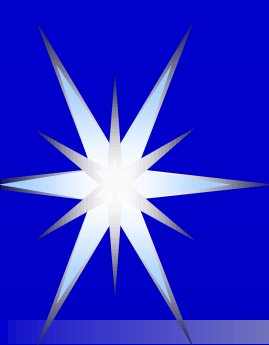
Basis for variation in ADG

- ↗ **Genetics**
- ↗ **Background**
 - ↗ body condition
 - ↗ Prior nutrition (range vs pre-fed)
- ↗ **Shrink**
 - ↗ Accounting for fill
 - ↗ Relationship between empty vs live weight
- ↗ **Environment**
 - ↗ Weather (month out)
 - ↗ Pen location
- ↗ **Space allowances**
 - ↗ pen
 - ↗ manger
 - ↗ drinker
 - ↗ shade
- ↗ **Delay start-up/ restricted energy intake**
- ↗ **Implant failure/ calendaring**
- ↗ **Diet acceptability/palatability**
 - ↗ forage quality
 - ↗ fat
 - ↗ excess ionophore
- ↗ **Nutritional deficiency/ excess**
 - ↗ metabolizable amino acids
 - ↗ excess sulfur
- ↗ **Inadequate feed mixing**
- ↗ **Health**
 - ↗ chronics
 - ↗ bulling
- ↗ **Digestive dysfunctions**
 - ↗ acidosis
 - ↗ bloat
- ↗ **Etc.**



Steps in visual review of pen lots

- ✓ Visual quality score (VQS)
 - ✓ “Grade” pens of cattle (within gender)
 - ✓ Scale : A, B, C (average), D, E
 - ✓ $A = C - .50$
 - ✓ $B = C - .25$
 - ✓ $D = C + .25$
 - ✓ $E = C + .50$
 - ✓ Within gender, grade 3 random sets of 10 consecutive candidate pens
 - ✓ Candidate pens have 20 to 40 DOF (if feasible)
 - ✓ May be selected ahead of time from call sheet



Apply VQS to data in growth performance audit

1.35	2.26	344.33	577.67	1.55	548.87	153.73	1.53	8.82	0.99
0.35	0.17	0.13	0.06	0.08	0.07	0.16	0.12	0.09	0.10
		HEIFER VQS	2.2		STEER VQS	2.25			

									ADG Ratio
GENDER	FRAME	IW	FW	prdADG	FSBW	DOF	ADG	DMI	
1	2.31	355.45	595.35	1.61	569.14	152.85	1.58	9.01	0.98
2	2.18	323.30	544.21	1.43	510.51	155.38	1.44	8.47	1.00

0.19	1.41	2.16	8.96	1.02	82.00	17.32	1.22	3.38	5.80
0.07	0.10	0.00	0.09	0.05	0.00	0.95	0.95	0.69	0.09

				DMI RATIO						FG
cof	cog	NM	EXPDMI		PDM	PMORB	DEATH	SHRINK		
0.19	1.39	2.16	9.14	1.02	82.00	17.85	1.19	1.19		5.67
0.19	1.45	2.16	8.62	1.02	82.00	17.95	1.27	3.51		5.73



Performance evaluation

➤ Variance ratio

➤ Observed/expected ADG

➤ Measures deviation ADG based on observed cattle quality measures

➤ Expected/observed DMI

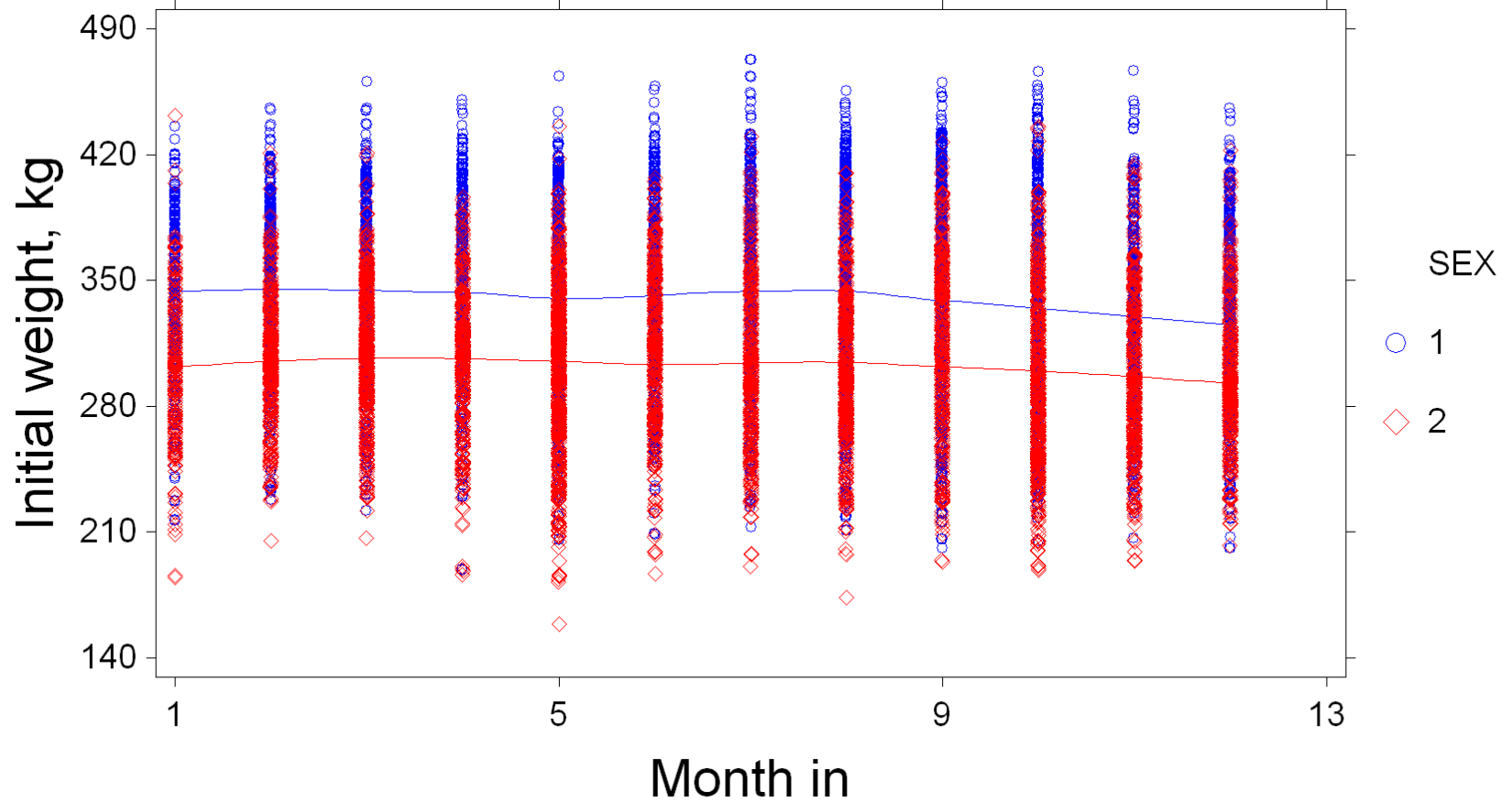
➤ Measure of deviation of energy intake from energy gain



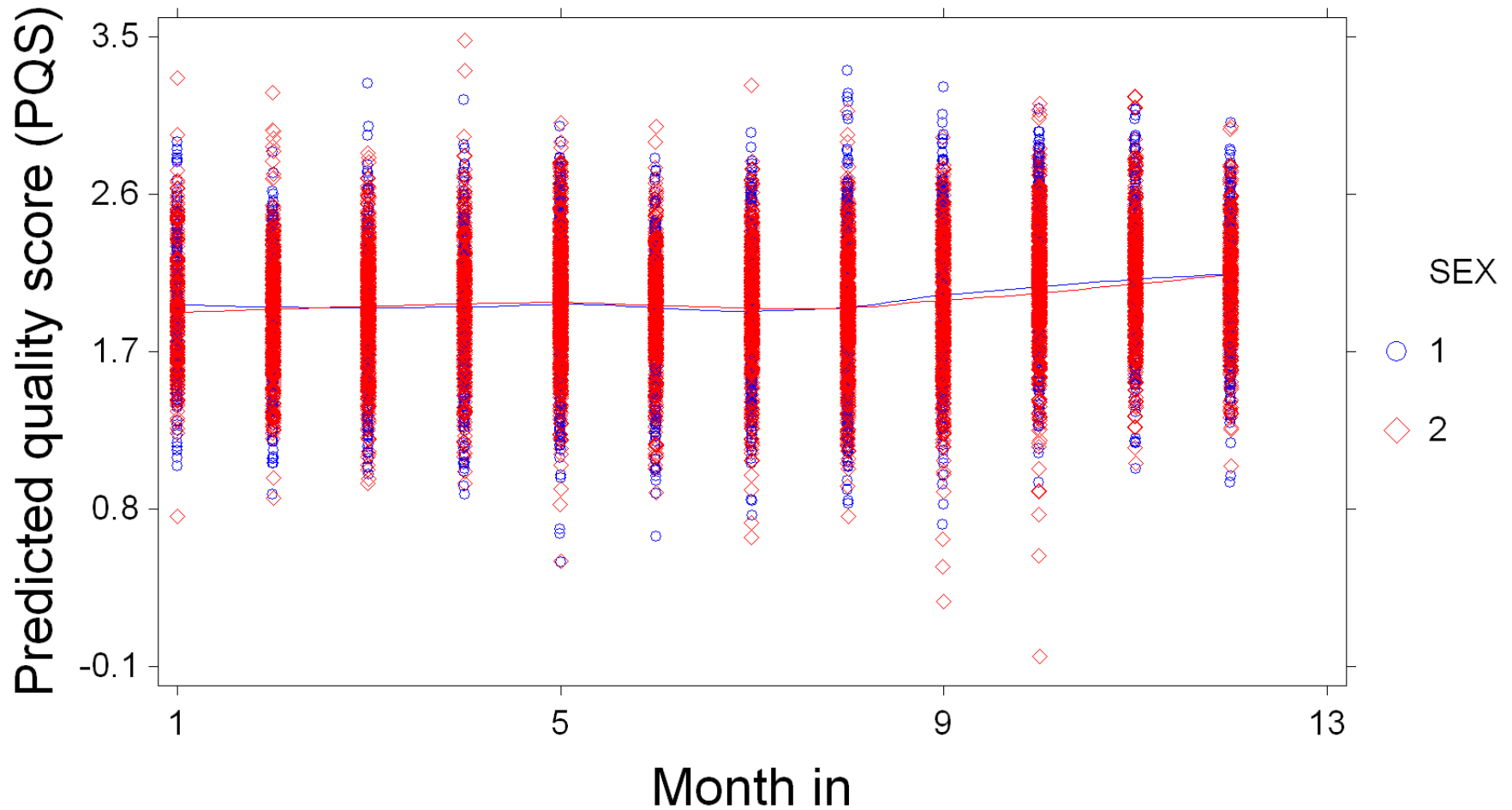
Sources of performance variance

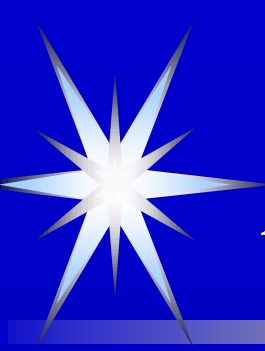
- **Negative associative dietary effect**
- **Failure to implant/faulty implant**
- **Improper implanting technique**
- **Environment/ reflects in harvest month**
 - **Lack of adequate shade or shelter**
 - **Muddy pens**
- **Pen location**
- **Manger orientation**

Arrival month vs initial weight

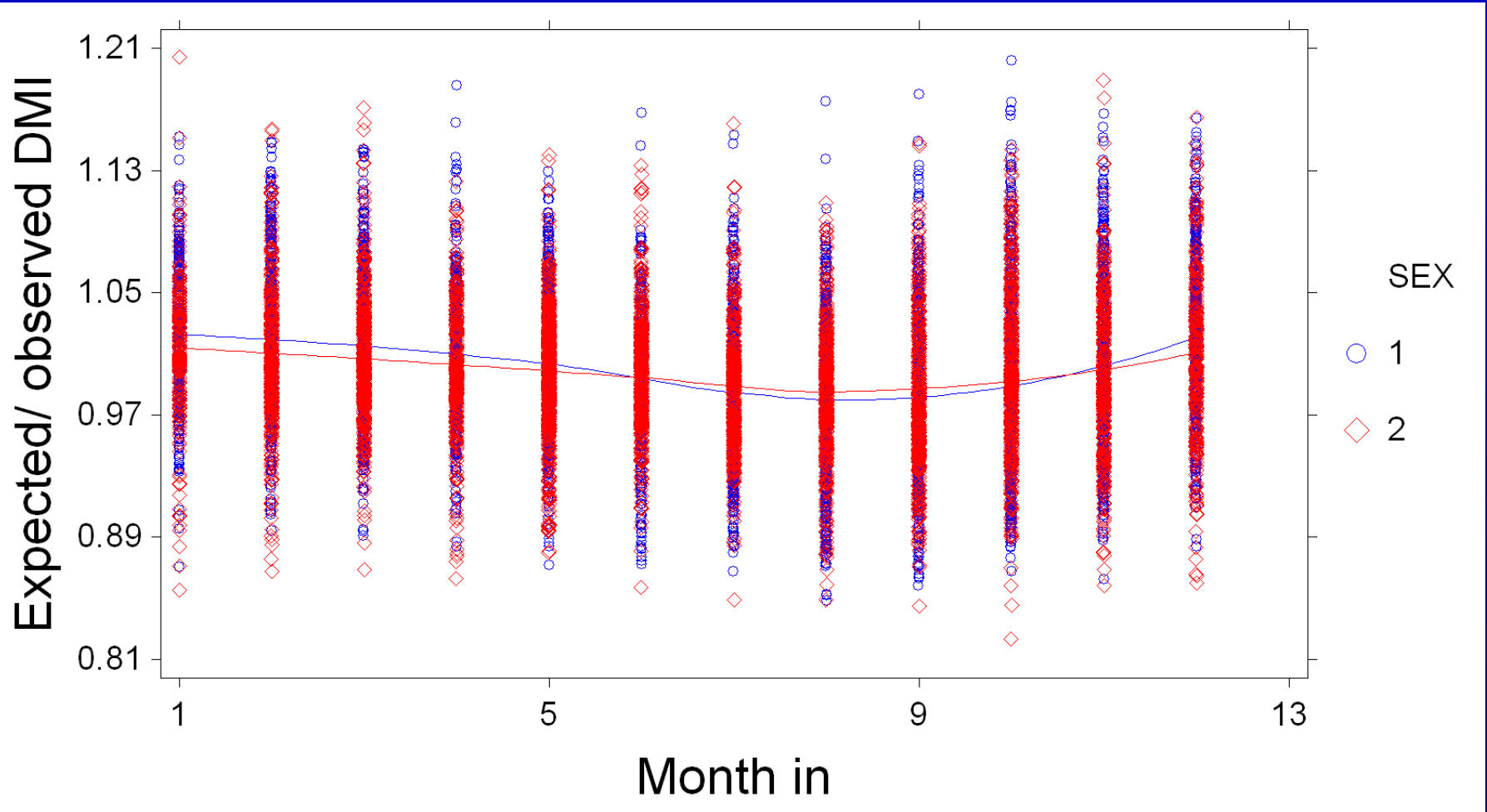


Arrival month vs predicted quality score

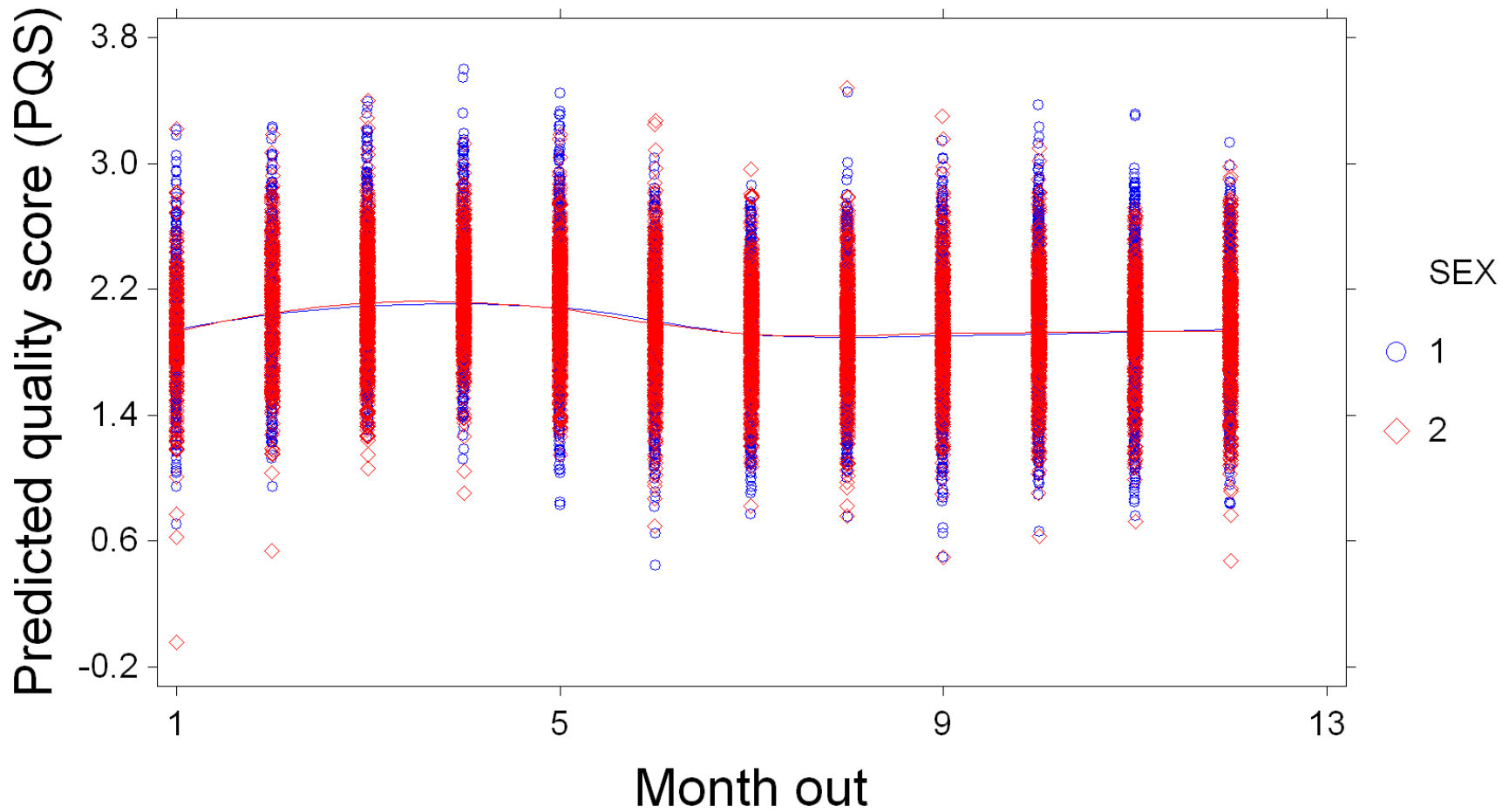




Arrival month vs DMI ratio



Harvest month vs predicted QS

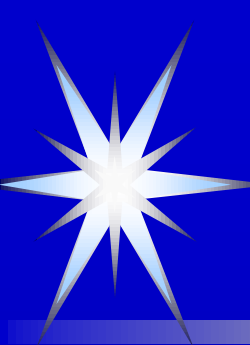




Sources of variance:

Double shade

	Shade	
	Single (2 m sq)	Double (4 m sq)
Initial wt, kg	327	309
Obs ADG, kg	1.54	1.65
Exp ADG, kg	1.66	1.65
Obs DMI, kg/d	9.3	9.1
Exp DMI, kg/d	9.4	9.6
Obs FG	6.02	5.51
Exp FG	6.10	5.82
ADG ratio	0.93	1.00
DMI ratio	1.01	1.05



Shade space

Heifers

F = 3.243 P = .022

SHADE SPACE, SQ M/HD	#	ADG ratio
< 1.5 SQ M	32	0.98
>= 1.5 And < 2 SQ M	131	1.00
>= 2 And < 2.5 SQ M	76	1.03
>= 2.5 SQ M	168	1.05



Water source vs ADG ratio

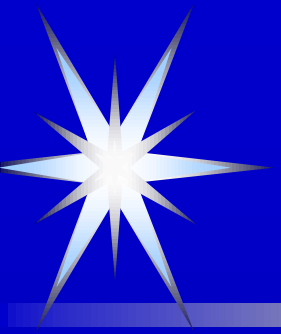
Heifer close-outs

P = 0.011

Water source	#	ADG ratio
Well 1	237	1.00
Well 2	68	1.03

P = .99

Water source	#	DMI ratio
Well 1	237	1.01
Well 2	68	1.01



Sources of variance:

Orientation of feed bunk

Summer close-outs

Bunk orientation

Item	North	South
Initial wt, kg	393	399
Obs ADG, kg	1.70	1.60
Exp ADG, kg	1.71	1.71
DMI (obs), kgs/d	10.5	10.8
DMI (exp), kgs/d	10.5	10.2
ADG ratio	0.99	0.94
DMI ratio	1.00	0.94

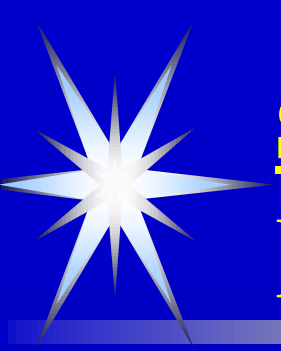


Sources of variance:

Orientation of feed bunk

Summer close-outs

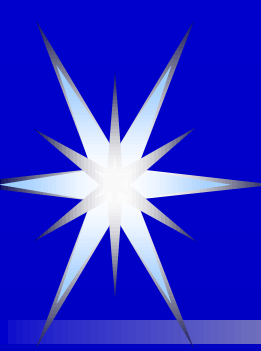
Item	Bunk orientation	
	North	South
Initial wt.	326	324
Obs ADG, kgs	1.62	1.43
Exp ADG, kgs	1.66	1.66
DMI (obs), kgs/d	9.32	9.14
DMI (exp), kgs/d	9.68	9.11
ADG ratio	0.97	0.86
DMI ratio	1.04	1.00



Sources of variance:

Lot location

Item	Lot location	
	Local	Off-site
Initial wt, kg	290	294
Obs ADG, kg	1.93	1.41
Exp ADG, kg	1.75	1.75
Obs DMI, kgs/d	9.00	7.68
Exp DMI, kgs/d	9.41	8.13
ADG ratio	1.10	0.81
DMI ratio	1.04	1.06



Conclusions:

➤ **Reliable standards exist**

➤ **Benchmarks**

- **Recognition of performance variance**
- **Directing management focus**
- **Useful filter for detecting data entry errors**



Minimum information for calculation of “Variance Ratios”

- Description of cattle/ gender**
- Initial and final shrunk live weight**
- Maintenance requirement**
- Dry matter intake**
- Average daily gain**
- Expected diet NEm based on formulation**
- Calculate energy gain**